DOCUMENT RESUME

ED 336 574 CE 058 958

AUTHOR	Reneau, Fred; And Others
TITLE	Ornamental Horticulture Production Occupations. Curriculum Guide.
INSTITUTION	Southern Illinois Univ., Carbondale. Dept. of Agricultural Education and Mechanization.
SPONS AGENCY	Illinois State Board of Education, Springfield. Dept. of Adult, Vocational and Technical Education.
PUB DATE	Jun 88
NOTE	838p.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF05/PC34 Plus Postage.
DESCRIPTORS	Agricultural Education; Behavioral Objectives; Business Administration; *Competency Based Education; Criterion Referenced Tests; Curriculum Guides; Equipment Maintenance; *Harvesting; Job Skills; Learning Activities; *Ornamental Horticulture; *Ornamental Horticulture Occupations; Plant Growth; *Plant Propagation; Postsecondary Education; *Salesmanship; Secondary Education; Soil Science; Student Evaluation

ABSTRACT

This curriculum guide contains guidesheets for the ornamental horticulture production occupations. Each guidesheet provides a job-relevant task; performance objective, with task, performance standard, source of standard, and conditions for performance of task; enabling objectives; a list of resources; teaching activities; a criterion-referenced measure; performance guide; and evaluation checklist. A total of 165 performance objectives are categorized into seven duties: (1) performing administrative functions; (2) preparing soil and growing media; (3) propagating horticultural plants; (4) growing plants; (5) performing maintenance operations; (6) harvesting plants; and (7) performing sales. Appendixes include a task list and job titles, definition of terms, tool and equipment list, 234-item bibliography, 13-item state-of-the-art literature bibliography, and 22-item sources of standards bibliography. (YLB)

****

* Reproductions supplied by EDRS are the best that can be made *

* from the original document. *

****

ED336574

A CURRICULUM GUIDE

FOR

ORNAMENTAL HORTICULTURE PRODUCTION OCCUPATIONS

CIP Code: 02.0404

for the Job Titles of

Specialty Grower - DOT:405.161-018

Plant Propagator - DOT:405.361-010

Horticultural Worker I - DOT:405.684-014

Horticultural Worker II - DOT:405.687-014

developed by

Fred Reneau, Project Director
Joseph Matthews, Research Specialist
David Hahn, Research Specialist
Department of Vocational Education Studies
Department of Agricultural Education and Mechanization
Southern Illinois University
Carbondale, Illinois 62901

in cooperation with

Peggy Pool, Technical Coordinator
Department of Adult Vocational and Technical Education
Illinois State Board of Education
100 North First Street
Springfield, Illinois 62777

CE058958

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

June 1988

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

F Beauman

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

ACKNOWLEDGMENTS

The Ornamental Horticulture Production Occupations Guide was developed by horticulture business persons, workers and educators in Illinois.

V-TECS Technical Coordinator (Illinois)

Peggy Pool, Contract Administrator
Department of Adult Vocational and Technical Education
Illinois State Board of Education
100 North First Street
Springfield, IL 62777

V-TECS Central Office Staff Representative

Dr. Ronald McCage
Vocational-Technical Education Consortium of States
Commission on Occupational Education Institutions
Southern Association of Colleges and Schools
1866 Southern Lane
Decatur, GA 30033-4097

Ornamental Horticulture Incumbents

Margaret Rehagen
Plantscape Nursery
and Landscape Service
Colp Road
Herrin, IL 62948

Harvey Hartline
Hartline Farm Nursery
RR 2 Box 23
Makanda, IL 62958

Carol Etzkorn
Anna Nursery
P.O. Box 150
Anna, IL 62906

Miles Imel
Greenhouse Supervisor
Southern Illinois University
Carbondale, IL 62901

Ernest Dietrich
Route 1
Dundas, IL. 624259

Randy Weir
713 Clinton
Paris, IL. 61944

Don Mueller
Harwood Nursery
614 Raffel Rd.
Woodstock, IL. 60098

Jon Carlson
J. Carlson Growers
8938 Newburg Rd.
Rockford, IL. 61108

Ornamental Horticulture Instructors

Jim Morrison
Horticulture Instructor
Collinsville High School
2201 South Morrison
Collinsville, IL 62234

Randey Wall
Horticulture Instructor
Illinois Central College
East Peoria, IL 61635

Carol Quenett
Horticulture Instructor
Kishwaukee College
Route 38
Malta, IL 60150

Don Newcomb
Horticulture Instructor
Triton College
2000 5th Ave.
River Grove, IL. 60171

Charles Giedeman
Horticulture Instructor
Belleville Area College
2500 Carlyle Rd.
Belleville, IL 62221

Jim Ethridge
Department Chairman
Agriculture Department
Joliet Junior College
1216 Houbolt Ave.
Joliet, IL 60436

John Preece
Professor of Plant and Soil Science
Southern Illinois University
Carbondale, IL 62901

TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS i

TABLE OF CONTENTS iii

INTRODUCTION 1

USE OF V-TECS GUIDES 5

CURRICULUM GUIDESHEETS 7

DUTY A: PERFORMING ADMINISTRATIVE FUNCTIONS

Maintain horticultural supply and stock inventory 8
Maintain equipment inventory. 13
Prepare equipment purchase orders 17
Prepare supply orders 22
Store stock and supplies. 27
Plan plant stock production needs 31
Plan work orders. 36
Determine daily assignments 39
Maintain payroll records. 42
Prepare payroll checks. 53
Maintain accounts receivable records. 64
Maintain accounts payable records 73
Maintain fiscal balance sheet records 87
Employ business personnel 92
Train employees 96
Evaluate employee performance 100
Dismiss employees 103
Prepare state and federal reports 106
Maintain trade organization certification 110
Supervise employees 113
Maintain employee benefit records 117
Estimate labor requirements 121
Plan plant production schedules 125
Plan plant propagation schedules. 129
Determine method of propagation 133

DUTY B: PREPARING SOIL AND GROWING MEDIA

Collect soil samples. 137
Test soil sample. 143
Pasteurize growing media. 148
Sterilize media with chemical soil sterilant. . . 154
Mix growing media 160
Alter pH of growing media 164
Prepare compost pile. 169
Calculate fertilizer requirements 173
Incorporate fertilizer into growing media 177
Prepare mulch beds for storage of plant materials 180
Haul topsoil. 184
Spread topsoil to establish a grade 188
Incorporate compost 192
Perform soil erosion control practices. 195
Prepare seedbed 199
Aerate sod. 203
Top dress lawn. 207

DUTY C: PROPAGATING HORTICULTURAL PLANTS

Test seeds for germination percentage 211
Sow seeds 216
Stratify seeds. 222
Scarify seeds 227
Prick off seedlings 233
Harden off seedlings. 238
Transplant seedlings. 242
Take cuttings 248
Stick cuttings in medium other than water or mist 258
Apply growth regulator to cuttings. 262
Remove cuttings from the propagating area 268
Harden off cuttings 272
Propagate plants using approach grafting. 276
Propagate plants using bark grafting. 282
Propagate plants using bridge grafting. 288
Propagate plants using cleft grafting 294
Propagate plants using inarch grafting. 300
Propagate plants using side grafting. 305
Propagate plants using splice grafting. 313
Propagate plants using wedge grafting 318
Propagate plants using whip and tongue grafting. 324
Propagate plants using T-budding. 330
Propagate plants using chip budding 336
Propagate plants using air layering 342

DUTY C: PROPAGATING HORTICULTURAL PLANTS (cont.)

Propagate plants using mound layering 347
Propagate plants using trench layering 352
Propagate plants using serpentine layering. . . . 357
Propagate plants by division. 362
Set time clocks for mist system 366
Identify spacing for species during propagation 370
Prepare tissue culture growing medium 375
Prepare explants for Stage I. 381
Transfer shoot cultures 388
Lay sod 395

DUTY D: GROWING PLANTS

Irrigate field grown plants 399
Irrigate container grown plants 403
Prune plants. 407
Shear plants. 413
Pot plants. 417
Transplant trees and shrubs 423
Lay barrier 429
Plant cover crops 434
Apply mulch to a planting bed 438
Label plants. 441
Disbud plants 444
Stake plants. 449
Pinch plants. 453
Perform simple plant tissue test. 457
Interpret simple plant tissue test. 461
Calculate liquid fertilizer concentrations . . . 465
Prepare fertilizer solution 469
Fertilize plants. 472
Inspect crops for pests 478
Identify insects for insect control 483
Identify diseases for disease control 487
Identify weeds for weed control 492
Spray plants for pest control 495
Calculate pesticide concentrations. 501
Drench plants for pest/environmental control 505
Fumigate plants for pest control. 510
Apply granular pesticides 515
Control pests biologically. 520
Control pests mechanically. 523
Establish plant spacing 528
Regulate growing structure temperature. 533
Regulate growing structure humidity 537

DUTY D: GROWING PLANTS (cont.)

Control growing structure light intensity 541
Regulate plants photoperiod 545
Remove dead trees and shrubs. 549
Treat plant wounds. 553
Mow turf grass. 556
Roll sod. 560
Renovate turf 564
Reseed worn spots on turf 568
Regulate carbon dioxide in a greenhouse 572
Apply growth regulator to crops 576
Plant bulbs, corms, tubers, and tuberous roots 580
Plant grass stolons, sprigs, and plugs. 584

DUTY E: PERFORMING MAINTENANCE OPERATIONS

Prepare equipment for winter storage. 590
Construct temporary growing structures. 597
Construct planters and flats. 601
Sharpen hand tools and blades 605
Perform preventive maintenance of equipment . . . 609
Service engine oil and filters. 613
Perform minor engine tune-up. 617
Maintain irrigation systems 624
Glaze or recover greenhouse structures 628
Clean work area 633
Dispose of waste materials. 636
Replace drive chains. 640
Replace broken or stripped gears. 646
Lubricate equipment 650
Service drive belts 654
Clean equipment 659
Maintain pesticide applicator 663
Maintain growing structure heating system 669
Maintain growing structure cooling system 674
Order repair parts for equipment. 680

DUTY F: HARVESTING PLANTS

Collect seeds 683
Clean seeds 687
Package seeds 691
Store seeds 694
Collect plant materials 699
Store plant materials 703
Dig bareroot trees and shrubs 708
Ball trees and shrubs 713
Bundle plant materials. 719
Prepare plant materials for shipment. 722

DUTY F: HARVESTING PLANTS (cont.)

Grade plant materials 729
Cut flowers 734
Cut sod 738
Condition plant materials 742

DUTY G: PERFORMING SALES

Plan advertising program. 747
Conduct public relations activities 751
Present sales information to customer 754
Prepare sales invoice 757
Deliver products to customer. 762
Price horticultural products. 767
Display retail products 771
Deposit daily cash receipts 775
Complete daily sales reports. 780
Operate cash register 783
Estimate cost of customers' order 789

APPENDICES 792

A. TASK LIST AND JOD TITLES 793

B. DEFINITION OF TERMS 798

C. TOOL AND EQUIPMENT LIST 802

D. BIBLIOGRAPHY 807

INTRODUCTION

V-TECS guides are extensions of the V-TECS catalog. While the V-TECS catalogs compile duties, task performance objectives, and performance guides, the catalogs emphasize the psychomotor aspect of an occupation. In addition, V-TECS catalogs establish blueprints of the occupations, while V-TECS guides consider background information surrounding the tasks as will as the process of making inferences, generalization, and decisions. V-TECS guides take these aspects of the learning process in consideration, and go a step further by including job seeking skills, work attitudes, energy conservation practices, and safety.

Experience has shown that the art of learning can also be taught while teaching subject matter. Studies indicate that people need to learn how to learn. V-TECS guides are written to deal with this learning process as an efficient means of assisting instructors in the task of teaching.

V-TECS guides are centered around the three domains of learning: the Psychomotor, cognitive, and affective. The following is a brief explanation of the learning domains.

PSYCHOMOTOR

V-TECS guides are developed around the psychomotor tasks that are considered worker oriented. Psychomotor or manipulative skills such as tightening a nut, replacing a hubcap, or machining a key slot in a steel shaft, are identified in the V-TECS catalog, but the suggestions on how to learn to do these tasks are addressed in the V-TECS curriculum guides.

COGNITIVE

To perform psychomotor tasks, students must think. To tighten a nut they must know which way to turn it and when to stop turning it so that they won't strip the threads. If replacing a hubcap, there is a certain technique that may vary from one car to another. For example, start the hubcap by placing the cap in a tilted position and tapping it all the way around until it is seated. On a different model, it may be necessary to position the hubcap and snap it all at once. At any rate, students must think about what is being done. This is cognitive or a mental activity. Cognitive is defined as: what goes on in the mind about any job being done. V-TECS guide provide both the collateral knowledge and the impetus to apply cognition to psychomotor tasks.

Students gain the cognitive through both real and vicarious experiences. They may read, view tapes, memorize or practice a process or procedure until they are certain of it. To test their knowledge, students may be required to decide the procedure, method, or sequence for performance. This is decision making or cognitive activity in its highest form.

Cognition is that process by which information is stored and used. The voice that warns one of potential dangers, is cognition. It is cognition that tells one to lock and tag out the power supply to an electrical apparatus before starting to repair it. However, cognition does not apply only to safety. Good cognition, or thinking, can help employees do a job better and quicker. V-TECS curriculum guides provide for the cognitive aspects of learning.

AFFECTIVE

Curriculum writers, supervisors, and instructors often fail to assist students in acquiring a positive attitude toward themselves, their job, school or fellow students. V-TECS guides seek to provide assistance to the instructor in achieving positive attitudes. It is difficult for the instructor to identify little bits an pieces of desirable behavior for every unit and often harder yet to teach them. In this area, students might be judged on how well they clean up their work area, whether they showed up to do the job in time, or whether they must be told several times to do something. Potential employers are interested in student attitudes because attitudes directly reflect work habits.

A student's ability to succeed on the job depends largely on attitude. If, for example, students have the attitude: "Let someone else do it, " they could be in trouble. Realizing this, V-TECS curriculum guides include activities designed to help the student get along with others.

USE OF V-TECS CURRICULUM GUIDE

The curriculum guides are designed to provide job-relevant tasks, performance objectives, performance guides, resources, learning activities, evaluation standards and achievement testing in selected occupations.

A V-TECS guide is designed to be used with any teaching methods. If a lecture/demonstration method is best for you, you will find sufficient help to meet your needs. If, however, you prefer to use discussions or other methods that require student participation, the V-TECS curriculum guides can save preparation time and offer innovative methods and procedures. Further, this work takes into consideration students' attitudes, thinking skills, and mathematical reading skills.

The use of small groups in teaching can be helpful in a number of ways: (1) many students may feel inadequate due to their lack of background information in mechanical areas; (2) some may feel that they are physically incompetent or lack the necessary background experiences. A successful program can provide students with a sense of security by reinforcing positive attitudes while improving their skills and knowledge. The task/learner-centered approach can be achieved by allowing students to interact on a personal level. Confidence increases when students discover that they are an essential part of a team engaged in the learning-teaching process. Students learning to work without direct supervision, permits the instructor to vary instructional routines away from the lecture or other full-class methods.

The V-TECS curriculum guides provide suggestions for specific classroom activities. These activities are not meant to be restrictive but a suggested variety of learning activities for each task. Students may complete any or all parts of the activities.

CURRICULUM GUIDESHEETS

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 1

TASK: Maintain horticulture supply and stock inventory.

STANDARD OF PERFORMANCE OF TASK:

The physical count of horticulture supply items and stock must equal the ledger account of the supply items and stock. The ledger account must include description, name, size, stock code, cost, reorder number, and number of stock and each supply item.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Stock
Stock ledger
Supply items
Stock inventory forms

ENABLING OBJECTIVES:

1. Write or print information on ledger form.
2. Use calculator to add, subtract, multiply and/or divide.
3. Order stock and supply items.
4. Count inventory items.
5. Read product labels.
6. Arrange products alphabetically.
7. Predict demand for stock and supply items.

***RESOURCES:**

1. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
2. Kay, R. (1986). Farm management: Planning, control, and implementation (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Horticultural supply catalogs.
4. Ledger inventory forms.
5. Stock inventory forms.
6. Checklist - Maintaining horticulture supply and stock inventory.

TEACHING ACTIVITIES:

1. Discuss the importance of maintaining supply and stock inventory. (* 1 & 2)
2. Outline the procedures used to maintain supply and stock inventory.
3. Show examples of ledger inventory forms. (* 4)
4. Show examples of stock inventory forms. (* 5)
5. Present lecture on the parts of stock ledger form. (* 5)
6. Question students on how to determine the name, size and stock code for a stock or supply item. (* 3)
7. Demonstrate how to match an entry on the ledger to a stock or supply item.
8. Discuss the importance of accuracy when counting stock and supply items.
9. Question students on the possible consequences of missing stock and supply items.
10. List possible causes of discrepancies between the physical count of the items and the number of items listed on the ledger account.
11. Demonstrate how to update the ledger account. (* 1,2 & 4)
12. Present lecture on determining the number of items to keep on inventory.
13. Present lecture on determining the size of an order required to obtain a volume discount. (* 3)
14. Discuss the importance of accuracy and legibility when updating ledger account.
15. Assign each student a period of time for which to maintain the horticulture supply and stock inventory. (* 6)

CRITERION-REFERENCED MEASURE:

The student must match each item on the ledger account form to a stock or supply item, count all stock and supply items, list any discrepancies between the physical count and the ledger account, update the ledger account and determine a list of items to be reordered. All entries on the ledger account form must be matched to a stock or supply item or listed as part of a discrepancy, the physical count of items must be exact and the student must verbally explain the reasons for the items listed to be reordered.

PERFORMANCE GUIDE:

1. Obtain current ledger inventory and stock inventory forms.
2. Identify stock and supply items by name, size, description, and stock code.
3. Count stock and supply items.
4. Compare physical count to ledger account.
5. Identify cause of discrepancies.
6. Update ledger account.
7. Reorder stock and supply items if number required for reorder number is reached.

CHECKLIST

DUTY Performing Administrative Functions

TASK Maintain horticulture supply and stock inventory.

ENABLER

1. Write or print information on ledger form.
2. Use calculator to add, subtract, multiply and/or divide.
3. Order stock and supply items.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain horticulture supply and stock inventory.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Obtained current ledger inventory and stock inventory forms.		
2. Identified stock and supply items by:		
- Name.		
- Size.		
- Description.		
- Stock code.		
3. Counted stock and supply items.		
4. Compared physical count to ledger account.		
5. Identified any discrepancies.		
6. Updated ledger account.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
7. Reordered stock and supply items if number required for reorder number was reached.	________	________
8. Explained reasons why the stock and supply items were reordered.	________	________

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 2

TASK: Maintain equipment inventory.

STANDARD OF PERFORMANCE OF TASK:

The physical count of equipment must equal the count in the equipment inventory register. The equipment inventory register must include name, description, identification number, and expected life of equipment.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Nursery Management Administration And Culture.

CONDITIONS FOR PERFORMANCE OF TASK:

Equipment
Equipment register

ENABLING OBJECTIVES:

1. Identify the name of a piece of equipment and/or locate the identification number on a piece of equipment.
2. Describe the general condition of a piece of equipment in quantitative terms.
3. Recall the definitions of beginning inventory and ending inventory.

***RESOURCES:**

1. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
2. Doane's field and equipment record book. Danville, IL: Interstate Printers.
3. Kay, R. (1986). Farm management: Planning, control, and implementation (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
4. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
5. Checklist - Maintaining equipment inventory.

TEACHING ACTIVITIES:

1. Discuss the importance of maintaining an equipment inventory.
2. Outline the overall procedure used to maintain an equipment inventory.
3. Show examples of equipment registers. (* 2)
4. Present lecture on the parts of an equipment register. (* 2)
5. Question students on how to determine the name of a piece of equipment and/or locate the identification number on a piece of equipment.
6. Demonstrate how to match an entry on the equipment register to a piece of equipment by the equipment's name and/or identification number.
7. Demonstrate how to determine the piece of equipment's cost, date of purchase, expected life, depreciation schedule and function unit. (* 1)
8. Show examples of qualitative and quantitative descriptions of the general condition of the piece of equipment.
9. Demonstrate how to list equipment items not found.
10. Demonstrate how to compare the ending inventory to the beginning inventory. (* 2,3 & 4)
11. Assign each student a group of equipment items on which to perform an equipment inventory. (* 5)

CRITERION-REFERENCED MEASURE:

The student must match each entry on the equipment register to the piece of equipment, record any changes in the general condition of the equipment items, count all the equipment items, list any equipment items not found, compare ending and beginning inventory and record any discrepancies. All equipment items on the equipment register must be either matched to a piece of equipment or listed as missing, any changes in the general condition of the equipment must be recorded (quantitative description) the equipment items must be counted.

PERFORMANCE GUIDE:

1. Obtain equipment register.
2. Identify equipment items on register by name, identification number, cost, date of purchase, expected life, depreciation schedule, and functional unit of business where equipment will be primarily used.
3. Count equipment items.

PERFORMANCE GUIDE: (cont.)

4. Note any change in the general condition of each equipment item.
5. List equipment items not found on the equipment register.
6. Compare ending inventory to beginning inventory.
7. Account for any discrepancies.

CHECKLIST

DUTY Performing Administrative Functions

TASK Maintain equipment inventory.

ENABLER

1. Identify the name of a piece of equipment and/or locate the identification number on a piece of equipment.
2. Describe the general condition of a piece of equipment in quantitative terms.
3. Recall the definitions of beginning inventory and ending inventory.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain an equipment inventory.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Identified the equipment register.		
2.	Matched each items on the equipment register to a piece of equipment.		
3.	Recorded any changes in the general condition of each piece of equipment in quantitative terms.		
4.	Listed any equipment items not found.		
5.	Identified the beginning inventory.		
6.	Identified the ending inventory.		
7.	Recorded any discrepancy between the beginning and ending inventories.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 3

TASK: Prepare equipment purchase orders.

STANDARD OF PERFORMANCE OF TASK:

Purchase order preparation must include obtaining name of equipment item, model number, cost, description of equipment, vendor name and address, and authorization.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Nursery Management Administration and Culture.

CONDITIONS FOR PERFORMANCE OF TASK:

Order forms
Equipment list
Supply catalogs
Equipment inventory register
Seasonal production projections

ENABLING OBJECTIVES:

1. Identify horticultural equipment.
2. Write, print or type information on order forms.
3. File records according to a system.

***RESOURCES:**

1. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
2. Kay, R. (1986). Farm management: Planning, control, and implementation (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Horticultural equipment catalogs.
5. Order forms.
6. Checklist - Preparing equipment purchase orders.

TEACHING ACTIVITIES:

1. Question students on if they have personally made any major purchases.
2. Question students on the procedures they used to find the best value.
3. Outline procedures used to prepare equipment purchase orders. (* 1,2 & 3)
4. List equipment used in a horticultural business.
5. List equipment items that are used seasonally.
6. List factors to consider in equipment selection. (* 1,2 & 3)
7. List sources available to help determine cost, features, and availability of spare parts and other equipment selection factors. (* 3 & 4)
8. Present lecture on the purpose of sending out an order for bids. (* 1,2 & 3)
9. Present lecture on information supplied to vendors when soliciting bids. (* 1,2 & 3)
10. Present lecture on factors to consider when evaluating vendors' bids. (* 1,2 & 3)
11. Show examples of order forms. (* 5)
12. Demonstrate how to complete the purchase order form.
13. Discuss the importance of obtaining authorization for purchases.
14. Discuss the importance of filing records accurately.
15. Assign each student a list of equipment items for which to prepare equipment purchase orders. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the factors to be considered in equipment selection, collect and list the information regarding the listed factors, describe the equipment for the vendors, send the order out for bids, select the vendor, complete the purchase order form and file a copy of the order. All factors that should be considered must be listed, all listed information must be accurate, the description of the equipment must include all required information (vendors respond without requiring additional information), the selected vendor offers the best value and records are accurate, legible and filed according to system.

PERFORMANCE GUIDE:

1. Check list of needed equipment.
2. Add any additional equipment needed to meet seasonal demands.
3. Consult catalogs and sales representatives to compare cost, features, availability of spare parts, and delivery date.
4. Record descriptive information about equipment such as model number and size.
5. Send order out for bid, if company policy dictates.
6. Select desired vendor.
7. Complete purchase order form:
    - A. Name and address of vendor.
    - B. Name of equipment item.
    - C. Model number/serial number.
    - D. Equipment description.
    - E. Cost.
    - F. Quantity.
    - G. Authorization.
8. Obtain authorization for purchase.
9. File copy of the order.

CHECKLIST

DUTY Performing Administrative Functions

TASK Prepare equipment purchase orders.

ENABLER

1. Identify horticultural equipment.
2. Write, print or type information on order forms.
3. File records according to a system.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare equipment purchase orders.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Listed needed equipment.		
2.	Listed additional equipment needed to meet seasonal demands.		
3.	Listed factors considered in equipment selection (i.e. cost, quality, warranty).		
4.	Listed descriptive information about equipment such as model number and size.		
5.	Sent order out for bids.		
6.	Selected vendor that offered best value.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
7.	Completed purchase order form:		
	- Name and address of vendor.		
	- Name of equipment item.		
	- Model number/serial number.		
	- Equipment description.		
	- Cost.		
	- Quantity.		
	- Authorization.		
	- Method of shipping.		
8.	Filled out order form (legible).		
9.	Obtained authorization for purchase.		
10.	Filed copy of the order.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 4

TASK: Prepare supply orders.

STANDARD OF PERFORMANCE OF TASK:

Purchase order preparation must include list and description of supplies, model number, cost, vendor's name and address, and authorization.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Nursery Management Administration and Culture.

CONDITIONS FOR PERFORMANCE OF TASK:

Order forms
Supply catalogs
Supply inventory ledger
Seasonal production projections

ENABLING OBJECTIVES:

1. Identify horticultural supply items.
2. Write, print or type information on order forms.
3. Recall the purpose of an inventory ledger.
4. File records according to a system.
5. Predict seasonal demand for supplies.

***RESOURCES:**

1. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
2. Kay, R. (1986). Farm management: Planning, control, and implementation (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Horticultural supply catalogs.
5. Order forms.
6. Checklist - Preparing supply orders.

TEACHING ACTIVITIES:

1. Question students on the procedures they use to find the best values when purchasing supplies.
2. Outline procedures used to prepare supply items purchase orders. (* 1,2 & 3)
3. List supplies used in a horticultural business.
4. Present lecture on determining what supplies are needed.
5. Question students on the purpose of an inventory ledger.
6. List sources available to help determine cost, features, and other supply selection factors. (* 4)
7. Present lecture on the purpose of sending out and order for bids. (* 1,2 & 3))
8. Present lecture on information supplied to vendors when soliciting bids. (* 1,2 & 3)
9. Present lecture on factors to consider when evaluating vendors' bids. (* 1,2 & 3)
10. Show examples of order forms. (* 5)
11. Demonstrate how to complete the purchase order form.
12. Discuss the importance of obtaining authorization for purchases.
13. Discuss the importance of filing records accurately.
14. Assign each student a list of supplies for which to prepare supply orders. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the factors to be considered in supply item selection, collect and list the information regarding the listed factors, describe the supply items for the vendors, send the order out for bids, select the vendor, complete the purchase order form and file a copy of the order. All factors that should be considered must be listed, all listed information must be accurate, the description of the supply items must include all required information (vendors respond without requiring additional information), the selected vendor offers the best value and records are accurate, legible and filed according to system.

PERFORMANCE GUIDE:

1. Obtain a list of needed supplies:
   A. Identify currently needed supplies by checking updated supply inventory ledger.
   B. Estimate supplies needed for upcoming orders.
   C. Estimate supplies needed for seasonal demands.
   D. List supply items which customers have inquired about and are presently not in stock.
2. Record descriptive information such as model, size and color.
3. Consult catalogs and/or sales representatives to compare cost, delivery date, and features on supplies.
4. Send order out for bid, if company policy dictates.
5. Select desired vendor.
6. Complete purchase order form:
   A. Name and address of vendor.
   B. Supply item and description.
   C. Model number.
   D. Cost.
   E. Quantity.
   F. Method of shipping.
7. Obtain authorization for purchase.
8. File a copy of the order.

CHECKLIST

DUTY Performing Administrative Functions

TASK Prepare supply orders.

ENABLER

1. Identify horticultural supply items.
2. Write, print or type information on order forms.
3. Recall the purpose of an inventory ledger.
4. File records according to a system.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare supply orders.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Listed supplies which are currently needed.		
2. Listed supplies needed for upcoming orders.		
3. Listed supplies needed for seasonal demands.		
4. Listed supply items which customers have inquired about and are presently not in stock.		
5. Listed descriptive information such as model, size and color.		
6. Listed factors to consider in selection of supplies.		
7. Sent order out for bid.		

	PERFORMANCE DETERMINANTS (cont.)	**YES**	**NO**
8.	Selected vendor offers the best value.	________	________
9.	Completed purchase order form:		
	- Name and address of vendor.	________	________
	- Supply item and description.	________	________
	- Model number.	________	________
	- Cost.	________	________
	- Quantity.	________	________
	- Method of shipping.	________	________
10.	Obtained authorization for purchase.	________	________
11.	Filed a copy of the order.	________	________

PERFORMANCE OBJECTIVE NO. 5

TASK: Store stock and supplies.

STANDARD OF PERFORMANCE OF TASK:

Specified stock and supplies must be organized and stored at specified temperature, humidity, and light conditions according to manufacturer's recommendations. Chemicals must be labeled and stored in locked area with required warning sign.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Locked area
Warning signs
Labels
Storage areas
Stock and supplies

ENABLING OBJECTIVES:

1. Read manufacturer's recommendations for storage.
2. Look up storage recommendations.
3. Recall horticultural chemical safety.
4. Identify horticultural stock and supply items.
5. Label horticultural stock and supply items.

***RESOURCES:**

1. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.
2. Boyd, J. (1979). Practical farm buildings. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Buchel, K. (1983). Chemistry of pesticides. Somerset, NJ: John Wiley and Sons, Inc.
4. The Interstate Printers and Publishers, Inc. (1983). Doane's field and equipment record book. Danville, IL: Author.
5. Extension Service publications.
6. Fertilizer label.

***RESOURCES:** (cont.)

7. Pesticide label.
8. Checklist - Storing stock and supplies.

TEACHING ACTIVITIES:

1. Question students on storage requirements of household items (detergents, milk, ice cream).
2. List horticultural stock and supplies that require special storage conditions. (* 1,2,5,6 & 7)
3. Stress the importance of avoiding deterioration of horticultural stock and supplies. (* 1,2,5,6, & 7)
4. Present lecture on regulating temperature, humidity and light in the storage area. (* 1)
5. Present lecture on storage requirements of durable items, perishable items, and horticultural chemicals. (* 1,2,5,6 & 7)
6. Stress the importance of labeling stored items, keeping chemicals in a locked area and posting warning signs.
7. Present lecture on information that should be included when labeling items for storage. (* 1,2,5,6 & 7)
8. Show an example of a stock room inventory sheet. (* 4)
9. Show examples of storage areas used for durable items, perishable items and horticultural chemicals.
10. Demonstrate how to fill out a stock room inventory sheet. (* 4)
11. Question students on the storage requirements of items to be stored.
12. Question students on horticultural chemical safety.
13. Assign each student a list of stock and supply items to store. (* 8)

CRITERION-REFERENCED MEASURE:

The student must identify the stock and/or supply items by name, record the storage requirements and safety considerations, label the items, place the items into storage and record the items on the stock room inventory sheet. The recorded storage requirement and safety considerations must meet the manufacturer's recommendations (test administrator's judgment), all items must be labeled, chemicals must be in locked area with required warning signs and all stored items must be recorded on the stock room inventory sheet.

PERFORMANCE GUIDE:

1. Identify environmental conditions favorable for the storage of specified stock and supplies:
    - A. Identify temperature requirements for specified stock or supplies.
    - B. Identify humidity requirements for specified stock or supplies.
    - C. Identify if stock or supplies must be protected from sunlight.
2. Identify areas to be used for storing specified stock and supplies.
3. Select areas within the storage areas to be used for storing specific supplies.
4. Place stock and supplies in the designated area for particular item:
    - A. Store chemicals in a cool, dry area that is locked and labeled with required warning signs.
    - B. Store stock and supplies that do not require specified environmental conditions where space allows within the designated storage areas.
5. Label and date all chemicals and perishable items.
6. Maintain stock room inventory sheet.

CHECKLIST

DUTY Performing Administrative Functions

TASK Store stock and supplies.

ENABLER

1. Read manufacture's recommendations for storage.
2. Look up storage recommendations.
3. Recall horticultural chemical safety.
4. Identify horticultural stock and supply items.
5. Label horticultural stock and supply items.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to store stock and supplies.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Listed temperature requirements for specified stock or supplies.		
2.	Listed humidity requirements for specified stock or supplies.		
3.	Listed if stock or supplies must be protected from sunlight.		
4.	Listed areas to be used for storing specified stock and supplies.		
5.	Labeled all items.		
6.	Stored chemicals in a cool, dry area that is locked and labeled with required warning signs.		
7.	Stored stock and supplies that do not require specified environmental conditions where space allows within the designated storage areas.		
8.	Listed all stored items on stock room inventory sheet.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 6

TASK: Plan stock plant production needs.

STANDARD OF PERFORMANCE OF TASK:

The date and number of propagules of each particular species must be obtained from the plant propagation schedule. The required number of stock plants of each particular species, the planting date for stock plants, and the amount of time needed between the harvesting of flushes of cuttings must be calculated.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Plant propagation schedule

ENABLING OBJECTIVES:

1. Use calculator to add, subtract, multiply and/or divide.
2. Recall factors that effect plant growth.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Bailey, L. (1949). Manual of cultivated plants. Fort Worth, TX: Branch-Smith Publishing.
5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Stock plant production schedule.
7. Checklist - Planning stock plant production needs.

TEACHING ACTIVITIES:

1. Discuss the importance of advanced planning.
2. Outline steps followed to complete a stock plant production schedule.
3. Show examples of plant propagation schedules. (* 6)
4. List the number of propagules needed and the date they are needed.
5. Question students on references available to identify plant growth characteristics. (* 4 & 5)
6. List the factors that can affect the plants growth rate.
7. List other factors that could influence the decision of when stock plants should be planted. (* 1,2 & 3).
8. Assign each student a plant species for which to plan the stock plant production needs. (* 7)

CRITERION-REFERENCED MEASURE:

The student must calculate and record the number of stock plants needed, the date the stock plants should be planted, and the date the stock plants will be ready. The recorded number of stock plants, the date the stock plants should be planted and the date the stock plants will be ready must allow enough time (test administrator's judgment) to produce the propagules needed (plus or minus 5%), on the day they are required (plus or minus 7 days).

PERFORMANCE GUIDE:

1. Obtain plant propagation schedule.
2. List the date and number of propagules of each particular species needed.
3. Calculate number of stock plants needed of each particular species and are ready for harvest on specified date:
    A. Estimate the number of propagules that can be taken from individual stock plants of each particular species.
    B. Divide the number of needed propagules of a particular species on specified date by the number of propagules harvested from an individual stock plant to find the number of stock plants needed on a specified date.

PERFORMANCE GUIDE: (cont.)

4. Schedule stock plant production:
    - A. Estimate amount of time needed from date stock plants are planted until date propagules can be harvested.
    - B. Estimate the amount of time required between the harvesting of flushes of propagules for each particular species.
    - C. Calculate the number of stock plants that need to be planted, the date stock plants should be planted, and the dates propagules may be harvested.

CHECKLIST

DUTY Performing Administrative Functions.

TASK Plan stock plant production needs.

ENABLER

1. Use calculator to add, subtract, multiply and/or divide.
2. Recall factors that effect plant growth.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plan stock plant production needs.

PERFORMANCE DETERMINANTS	YES	NO
1. Recorded the number of propagules needed for the assigned species.	______	______
2. Recorded the date that the propagules are needed.	______	______
3. Recorded the number of propagules that can be taken from each stock plant species.	______	______
4. Recorded how often the propagules can be taken from the stock plant.	______	______
5. Recorded the number of stock plants needed.	______	______
6. Recorded the amount of time required to grow stock plants.	______	______
7. Recorded the amount of time required between harvests of propagules.	______	______
8. Calculated the number of stock plants required.	______	______
9. Recorded the date the stock plants should be planted.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Recorded the anticipated dates for harvesting the propagules.	________	________
11. Identified plant's growth characteristics using a reference manual.	________	________

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 7

TASK: Plan work orders.

STANDARD OF PERFORMANCE OF TASK:

Jobs must be identified and assigned to functional unit of work force. Jobs must be identified, evaluated, and prioritized by scheduled date of completion.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Current orders
Plant production schedule

ENABLING OBJECTIVES:

1. Recall labor requirements of horticultural jobs.
2. Recall functional units (divisions or work crews) of horticultural businesses.

***RESOURCES:**

1. American Association of Nurserymen. Talking over foremanship [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
2. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
3. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
4. Kooi, C. (1985). Estimating and management principles for landscape contractors. Chicago, IL: American Nurseryman Publishing Co.
5. Production schedule.
6. Customer's order.
7. Checklist - Planning work orders.

TEACHING ACTIVITIES:

1. Discuss the importance of efficient use of employees.
2. List examples of horticultural jobs. (* 2,3,4,5 & 6)
3. List examples of seasonal jobs and routine jobs. (* 2,3,4,5 & 6)
4. Question students on dates that seasonal jobs and routine jobs are done. (* 2,3,4,5 & 6)
5. Present lecture on factors that effect scheduling of jobs (weather, labor supply, priority jobs). (* 1,2,3,4,5 & 6)
6. List examples of horticultural businesses.
7. Question students on the functional units or work crews of the listed horticultural businesses.
8. Present lecture on the purpose of identifying functional units or work crews within a business.
9. Question students on what functional unit(s) preform the listed seasonal and/or routine jobs.
10. Question students on factors to consider when scheduling jobs.
11. Assign each student a list of jobs performed at a horticultural business for which to plan work orders. (* 7)

CRITERION-REFERENCED MEASURE:

The student must record the date the jobs are scheduled to be completed, list factors that could delay and/or advance the completion of the job, prioritize the jobs and assign each job to a functional unit of the business. The student must be able to explain the reason(s) why certain jobs were given higher priority than others

PERFORMANCE GUIDE:

1. Identify jobs to be completed:
   A. Evaluate production schedule.
   B. Evaluate customers' orders.
   C. Identify routine jobs.
   D. Identify seasonal jobs.
2. Prioritize the jobs according to scheduled completion dates by giving top priority to jobs with the earliest completion date.
3. Divide work force into functional units to complete jobs.
4. Assign jobs to functional units.

CHECKLIST

DUTY Performing Administrative Functions

TASK Plan work orders.

ENABLER

1. Recall labor requirements of horticultural jobs.
2. Recall functional units (divisions or work crews) of horticultural businesses.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plan work orders.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Listed routine jobs and dates jobs must be completed.	______	______
2. Listed seasonal jobs and dates jobs must be completed.	______	______
3. Listed factors that could delay the completion of the job.	______	______
4. Listed factors that could advance the completion of the job.	______	______
5. Prioritized the jobs.	______	______
6. Listed functional units of horticultural business.	______	______
7. Assigned jobs to functional units.	______	______

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 8

TASK: Determine daily assignments.

STANDARD OF PERFORMANCE OF TASK:

Jobs which must be completed on specified date must be identified from work order. Worker's competencies must be matched with required job skills and jobs prioritized by scheduled time of completion. Number of jobs assigned to specific employee must be based on estimated job completion time.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Workers
Work orders
Specified jobs

ENABLING OBJECTIVES:

1. Recall purpose of a work order.
2. Identify skills required to perform horticulture jobs.
3. Estimate job completion time.
4. Recall factors to consider when prioritizing a worker's jobs.

***RESOURCES:**

1. American Association of Nurserymen. Talking over foremanship [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
2. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
3. Kooi, C. (1985). Estimating and management principles for landscape contractors. Chicago, IL: American Nurseryman Publishing Co.
4. Work order.
5. Checklist - Determining Daily Assignments.

TEACHING ACTIVITIES:

1. Discuss the importance of using work orders.
2. Show the parts of a work order. (* 4)
3. List types of jobs which may be on a work order. (* 2 & 3)
4. List skills required to perform jobs. (* 2 & 3)
5. List factors to consider when prioritizing a worker's jobs. (* 1 & 2)
6. Present lecture on matching a worker's competencies with the skills required to perform a job.
7. Demonstrate how to prioritize a worker's jobs.
8. Discuss how to determine estimated job completion time. (* 3)
9. Assign each student several work orders from which to determine daily assignments. (* 5)

CRITERION-REFERENCED MEASURE:

The student must list the jobs in order of priority and assign workers to each job. Each job must be listed so that it can be completed by the scheduled completion time on the job's work order and the worker's competencies must be matched to the required job skills.

PERFORMANCE GUIDE:

1. Identify jobs that must be completed on specified date from work order.
2. Identify worker's competencies.
3. Match worker's competencies with skills required for each specific job.
4. Organize each worker's jobs by giving priority to the jobs with the earliest scheduled time of completion.
5. Estimate the job completion time base on the number jobs assigned to each worker.

CHECKLIST

DUTY Performing Administrative Functions

TASK Determine daily assignments.

ENABLER

1. Identify skills required to perform horticulture jobs.
2. Estimate job completion time.
3. Recall factors to consider when prioritizing a worker's jobs.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to determine daily assignments.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Completed list of jobs and dates from work orders.		
2.	Listed workers and job titles.		
3.	Scheduled the jobs so as to allow enough time for completion by the scheduled job completion time.		
4.	Assigned each worker a job or jobs that matched the worker's competencies.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 9

TASK: Maintain payroll records.

STANDARD OF PERFORMANCE OF TASK:

Employee's gross pay must be calculated. All payroll deductions must be figured and deducted from gross pay. Gross pay, net pay, and deductions must be recorded in payroll register.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Payroll records
Tax tables
Salary/wages for each employee (time cards)

ENABLING OBJECTIVES:

1. Identify payroll deductions that are applicable to employee.
2. Use calculator to add, subtract, multiply and/or divide.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Tax booklets, available from federal, state and local taxing agencies.
5. Visual aid - Time cards.
6. Visual aid - Payroll records.
7. Worksheet - Maintaining payroll records.

TEACHING ACTIVITIES:

1. Discuss the importance of accuracy in record keeping.
2. Question students on the difference between gross pay and net pay.
3. Question students on payroll deductions.
4. List payroll deductions. (* 1,2,3, & 4)
5. Present lecture on calculating deductions using percentages. (* 4)
6. Present lecture on figuring deductions using tax tables. (* 4)
7. Show examples of time cards and completed payroll records. (* 5 & 6)
8. Show location of gross pay, deductions and net pay on the payroll register. (* 5)
9. Assign worksheet - Maintaining payroll records. (* 7)

CRITERION-REFERENCED MEASURE:

The student must calculate and record gross pay, deductions and net pay. The recorded gross pay, deductions and net pay must be accurate (plus or minus 1 penny).

PERFORMANCE GUIDE:

1. Calculate the gross pay for each employee.
2. Figure the employee's deductions:
   A. Income tax:
      1. Federal tax.
      2. State tax.
      3. City tax.
   B. FICA tax.
   C. Other taxes.
   D. Other deductions.
3. Record net pay and deductions in the payroll register.
4. Complete designated columns in payroll register.

VISUAL AID - TIME CARD

(SAMPLE BLANK TIME CARD)

EMPLOYEE______________________ RATE SCALE________________

DEPARTMENT____________________ FROM_________ TO___________

	REGULAR		OVERTIME		TOTAL HOURS	
	IN	OUT	IN	OUT	REGULAR	OVERTIME
MONDAY						
TUESDAY						
WEDNESDAY						
THURSDAY						
FRIDAY						
SATURDAY						
				WEEKLY TOTAL		

*NON-PRODUCTIVE TIME (LIST):

EMPLOYEE'S SIGNATURE SUPERVISOR'S SIGNATURE

________________________ ____________________________

*S=SICK LEAVE MB=MACHINE BREAKDOWN O=OTHER(EXPLAIN)
V=VACATION MU=MACHINE UNAVAILABLE

VISUAL AID (cont.) - TIME CARD

(SAMPLE COMPLETED TIME CARD)

EMPLOYEE Chris Mann RATE SCALE $8.00

DEPARTMENT Garden Center FROM May 2 TO May 8

	REGULAR		OVERTIME		TOTAL HOURS	
	IN	OUT	IN	OUT	REGULAR	OVERTIME
MONDAY	9	5			8	
TUESDAY	9	5	5	7	8	2
WEDNESDAY	9	5			8	
THURSDAY	9	5	5	8	8	3
FRIDAY	9	5			8	
SATURDAY						
				WEEKLY TOTAL	40	5

*NON-PRODUCTIVE TIME (LIST): None

EMPLOYEE'S SIGNATURE SUPERVISOR'S SIGNATURE

signed signed

*S=SICK LEAVE MB=MACHINE BREAKDOWN O=OTHER(EXPLAIN)
V=VACATION MU=MACHINE UNAVAILABLE

VISUAL AID - PAYROLL RECORDS

(SAMPLE BLANK PAYROLL RECORD BOOK)

			DEDUCTIONS				
DATE	EMPLOYEE	GROSS WAGES	FICA	FEDERAL W/HOLDING	STATE W/HOLDING	OTHER	NET PAY
____	________	_____	____	________	________	_____	_____
____	________	_____	____	________	________	_____	_____
____	________	_____	____	________	________	_____	_____
____	________	_____	____	________	________	_____	_____
____	________	_____	____	________	________	_____	_____
____	________	_____	____	________	________	_____	_____
TOTALS	========	=====	====	========	========	=====	=====

VISUAL AID (cont.) - PAYROLL RECORDS

(SAMPLE COMPLETED PAYROLL RECORD BOOK)

			DEDUCTIONS				
DATE	EMPLOYEE	GROSS WAGES	FICA	FEDERAL W/HOLDING	STATE W/HOLDING	OTHER	NET PAY
5/8	J. Jones	300.00	18.00	66.00	5.28	0	210.72
5/8	S. Smith	356.25	21.37	78.33	6.27	0	250.28
5/8	B. Wilson	320.00	19.20	70.40	5.63	0	224.77
TOTALS		976.25	58.57	214.73	17.18	0	685.77

WORKSHEET - MAINTAINING PAYROLL RECORDS

DIRECTIONS: Using the following time cards (Jim Jones, Sally Smith, and Bob Wilson) prepare the payroll records below.

Deductions for FICA, Federal Withholding, and State Withholding are calculated by a percentage of gross wages. The percentages are 6%, 22%, and 1.76% respectively.

			DEDUCTIONS				
DATE	EMPLOYEE	GROSS WAGES	FICA	FEDERAL W/HOLDING	STATE W/HOLDING	OTHER	NET PAY

TOTALS ==

WORKSHEET (cont.) - MAINTAINING PAYROLL RECORDS

(TIME CARDS)

EMPLOYEE Jim Jones RATE SCALE $7.50

DEPARTMENT Garden Center FROM May 2 TO May 8

	REGULAR		OVERTIME		TOTAL HOURS	
	IN	OUT	IN	OUT	REGULAR	OVERTIME
MONDAY	9	5			8	
TUESDAY	9	5			8	
WEDNESDAY	9	5			8	
THURSDAY	9	5			8	
FRIDAY	9	5			8	
SATURDAY						
				WEEKLY TOTAL	40	0

*NON-PRODUCTIVE TIME (LIST): None

EMPLOYEE'S SIGNATURE SUPERVISOR'S SIGNATURE

signed signed

*S=SICK LEAVE MB=MACHINE BREAKDOWN O=OTHER(EXPLAIN)
V=VACATION MU=MACHINE UNAVAILABLE

WORKSHEET (cont.) - MAINTAINING PAYROLL RECORDS

(TIME CARDS)

EMPLOYEE Sally Smith RATE SCALE $7.50

DEPARTMENT Garden Center FROM May 2 TO May 8

	REGULAR		OVERTIME		TOTAL HOURS	
	IN	OUT	IN	OUT	REGULAR	OVERTIME
MONDAY	9	5	5	6	8	1
TUESDAY	9	5	5	6	8	1
WEDNESDAY	9	5	5	6	8	1
THURSDAY	9	5	5	6	8	1
FRIDAY	9	5	5	6	8	1
SATURDAY						
				WEEKLY TOTAL	40	5

*NON-PRODUCTIVE TIME (LIST): None

EMPLOYEE'S SIGNATURE SUPERVISOR'S SIGNATURE

signed signed

*S=SICK LEAVE MB=MACHINE BREAKDOWN O=OTHER(EXPLAIN)
V=VACATION MU=MACHINE UNAVAILABLE

WORKSHEET (cont.) - MAINTAINING PAYROLL RECORDS

(TIME CARDS)

EMPLOYEE Bob Wilson RATE SCALE $8.00

DEPARTMENT Garden Center FROM May 2 TO May 8

	REGULAR		OVERTIME		TOTAL HOURS	
	IN	OUT	IN	OUT	REGULAR	OVERTIME
MONDAY						
TUESDAY						
WEDNESDAY						
THURSDAY						
FRIDAY						
SATURDAY						
				WEEKLY TOTAL		

*NON-PRODUCTIVE TIME (LIST):40 hours (V)

EMPLOYEE'S SIGNATURE

signed

SUPERVISOR'S SIGNATURE

signed

*S=SICK LEAVE MB=MACHINE BREAKDOWN O=OTHER(EXPLAIN)
V=VACATION MU=MACHINE UNAVAILABLE

WORKSHEET ANSWER KEY - MAINTAINING PAYROLL RECORDS

			DEDUCTIONS				
DATE	EMPLOYEE	GROSS WAGES	FICA	FEDERAL W/HOLDING	STATE W/HOLDING	OTHER	NET PAY
5/8	J. Jones	300.00	18.00	66.00	5.28	0	210.72
5/8	S. Smith	356.25	21.37	78.33	6.27	0	250.28
5/8	B. Wilson	320.00	19.20	70.40	5.63	0	224.77
TOTALS		976.25	58.57	214.73	17.18	0	685.77

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 10

TASK: Prepare payroll checks.

STANDARD OF PERFORMANCE OF TASK:

Payroll checks and check stub must be completed and entered in the check record book. The payroll check and check stub must include date, employee's name, and amount of payment. The check stub must also include the check number.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Checkbook
Payroll records
Check record book

ENABLING OBJECTIVES:

1. Copy spelling of employee's name.
2. Use a calculator to add, subtract, multiply and/or divide.
3. Look up day of month on calendar.
4. Type, print, or write words and columns of numbers.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Payroll records
5. Visual aid - Payroll checks.
6. Visual aid - Check record book.
7. Visual aid - Payroll records.
8. Worksheet - Preparing payroll checks.

TEACHING ACTIVITIES:

1. Question students in regard to: "How do people react when they receive a check that is inaccurately filled out?"
2. Discuss the importance of completing checks accurately.
3. Discuss the importance of keeping a record of checks written.
4. Show examples of completed checks. (* 5)
5. Show an example of a completed check record book. (* 6)
6. Show an example of completed payroll records. (* 7)
7. Show the location of the employee's name, gross pay, deductions and net pay in the payroll records, on the payroll check and on the check stub.
8. Show location of the employee's name, check number and check amount in check record book.
9. Present lecture on requirements of a valid check. (* 1,2 & 3)
10. Assign worksheet - Preparing payroll checks. (* 8)

CRITERION-REFERENCED MEASURE:

The student must complete the sample check and check stub and record the check on the check record book. The completed check must meet all requirements of a validly written check and the information required in the check record book must be complete, accurate and legible (test administrator's judgment).

PERFORMANCE GUIDE:

1. Complete check for each employee:
    A. Date.
    B. Employee's name.
    C. Amount of payment:
        1. Payment amount in numbers.
        2. Written payment amount.
2. Complete check stub:
    A. Check number.
    B. Date.
    C. Employee's name.
    D. Amount of payment.
3. Record payment in check record book.

VISUAL AID - PAYROLL CHECKS

(SAMPLE BLANK PAYROLL CHECK)

(check stub)

XYZ Nursery

EMPLOYEE ____________

GROSS ____________

FICA ____________

FEDERAL ____________

STATE ____________

OTHER ____________

TOTAL ____________

NET PAY ____________

(payroll check)

XYZ Nursery # 0000
RR 1
Anytown, IL ____________19____

PAY TO THE ORDER
OF ______________________________ $________

________________________________DOLLARS

1st BANK
200 W. Second
Anytown, IL

memo __________ ____________________

VISUAL AID (cont.) - PAYROLL CHECKS

(SAMPLE COMPLETED PAYROLL CHECK)

(check stub)		(payroll check)
XYZ Nursery		
EMPLOYEE	Chris Mann	XYZ Nursery # 0000 RR 1
GROSS	____356.27	Anytown, IL __7/1_____1988__
FICA	_____21.37	
FEDERAL	_____78.33	PAY TO THE ORDER OF Chris Mann______________ \$250.30
STATE	______6.27	two hundred fifty and 30/100DOLLARS
OTHER	______0.00	1st BANK 200 W. Second
TOTAL	____105.97	Anytown, IL
NET PAY	____250.30	memo ________ ____signed______

VISUAL AID - CHECK RECORD BOOK

(SAMPLE BLANK CHECK RECORD BOOK)

check #	date	employee	amount

(SAMPLE COMPLETED CHECK RECORD BOOK)

check #	date	employee	amount
0000	7/1/88	Chris Mann	250.30

VISUAL AID - PAYROLL RECORDS

(SAMPLE BLANK PAYROLL RECORD BOOK)

			DEDUCTIONS				
DATE	EMPLOYEE	GROSS WAGES	FICA	FEDERAL W/HOLDING	STATE W/HOLDING	OTHER	NET PAY
TOTALS							

VISUAL AID (cont.) - PAYROLL RECORDS

(SAMPLE COMPLETED PAYROLL RECORD BOOK)

			DEDUCTIONS				
DATE	EMPLOYEE	GROSS WAGES	FICA	FEDERAL W/HOLDING	STATE W/HOLDING	OTHER	NET PAY
5/8	J. Jones	300.00	18.00	66.00	5.28	0	210.72
5/8	S. Smith	356.25	21.37	78.33	6.27	0	250.28
5/8	B. Wilson	320.00	19.20	70.40	5.63	0	224.77
TOTALS		976.25	58.57	214.73	17.18	0	685.77

WORKSHEET - PREPARING PAYROLL CHECKS

DIRECTIONS: Using the payroll records for the following employees (Jim Jones, Sally Smith, and Bob Wilson) to prepare their payroll checks.

			DEDUCTIONS				
DATE	EMPLOYEE	GROSS WAGES	FICA	FEDERAL W/HOLDING	STATE W/HOLDING	OTHER	NET PAY
5/8	J. Jones	300.00	18.00	66.00	5.28	0	210.72
5/8	S. Smith	356.25	21.37	78.33	6.27	0	250.28
5/8	B. Wilson	320.00	19.20	70.40	5.63	0	224.77

(check stub)

XYZ Nursery

EMPLOYEE ____________

GROSS ____________

FICA ____________

FEDERAL ____________

STATE ____________

OTHER ____________

TOTAL ____________

NET PAY ____________

(payroll check)

XYZ Nursery # 0001
RR 1
Anytown, IL ____________19____

PAY TO THE ORDER
OF ______________________________ $________

______________________________DOLLARS

1st BANK
200 W. Second
Anytown, IL

memo ________ ________________

WORKSHEET (cont.) - PREPARING PAYROLL CHECKS

(check stub)	(payroll check)
XYZ Nursery	
EMPLOYEE ____________	XYZ Nursery # 0002 RR 1
GROSS ____________	Anytown, IL ____________19____
FICA ____________	
	PAY TO THE ORDER
FEDERAL ____________	OF ______________________________ $________
STATE ____________	______________________________DOLLARS
OTHER ____________	1st BANK 200 W. Second
TOTAL ____________	Anytown, IL
NET PAY ____________	memo __________ ____________________

(check stub)	(payroll check)
XYZ Nursery	
EMPLOYEE ____________	XYZ Nursery # 0003 RR 1
GROSS ____________	Anytown, IL ____________19____
FICA ____________	
	PAY TO THE ORDER
FEDERAL ____________	OF ______________________________ $________
STATE ____________	______________________________DOLLARS
OTHER ____________	1st BANK 200 W. Second
TOTAL ____________	Anytown, IL
NET PAY ____________	memo __________ ____________________

WORKSHEET ANSWER KEY - PREPARING PAYROLL CHECKS

(check stub)

XYZ Nursery

EMPLOYEE	Jim Jones
GROSS	____300.00
FICA	_____18.00
FEDERAL	_____66.00
STATE	______5.28
OTHER	______0.00
TOTAL	_____89.28
NET PAY	____210.72

(payroll check)

XYZ Nursery # 0001
RR 1
Anytown, IL ___mm/dd__1988__

PAY TO THE ORDER
OF Jim Jones______________ $210.72

two hundred ten and 72/100__DOLLARS

1st BANK
200 W. Second
Anytown, IL

memo ________ ____signed______

(check stub)

XYZ Nursery

EMPLOYEE	Sally Smith
GROSS	____356.25
FICA	_____21.37
FEDERAL	_____78.33
STATE	______6.27
OTHER	______0.00
TOTAL	____105.97
NET PAY	____250.28

(payroll check)

XYZ Nursery # 0002
RR 1
Anytown, IL ___mm/dd__1988__

PAY TO THE ORDER
OF Sally Smith______________ $250.28

two hundred fifty and 28/100DOLLARS

1st BANK
200 W. Second
Anytown, IL

memo ________ ____signed______

WORKSHEET ANSWER KEY (cont.) - PREPARING PAYROLL CHECKS

(check stub)

XYZ Nursery

EMPLOYEE	Bob Wilson
GROSS	320.00
FICA	19.20
FEDERAL	70.40
STATE	5.63
OTHER	0.00
TOTAL	95.23
NET PAY	224.77

(payroll check)

XYZ Nursery # 0003
RR 1
Anytown, IL ___mm/dd__1988__

PAY TO THE ORDER
OF Bob Wilson $224.77

two hundred twenty-four
and 77/100 _____DOLLARS

1st BANK
200 W. Second
Anytown, IL

memo ________ ____signed______

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 11

TASK: Maintain accounts receivable records.

STANDARD OF PERFORMANCE OF TASK:

Accounts receivable records must include customer's name, account number, money owed, money paid, and current account balance. Accounts receivable information must be recorded on a back-up file and filed in accordance with filing system.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Invoices
Order forms
Filing system
Accounts receivable records

ENABLING OBJECTIVES:

1. File records according to system.
2. Type, print, write or program information on forms.
3. Mark dates on a calendar.
4. Recall meaning of horticultural terms for product size, packaging, and shipping codes.
5. Use calculator to add, subtract, multiply, and/or divide.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Visual aid - Invoice.
5. Visual aid - Order form.
6. Visual aid - Accounts receivable records.
7. Worksheet - Maintaining accounts receivable records.

TEACHING ACTIVITIES:

1. Discuss the importance of timeliness and accuracy of records when maintaining accounts receivable records.
2. List possible customers to a horticultural business. (* 1,2 & 3)
3. Show examples of invoices and sales orders.
4. Present lecture on comparing invoices to order forms. (* 4 & 5)
5. Question students regarding the possible customer reaction if a customer received a bill for something they had not ordered or had not received.
6. Show examples of completed accounts receivable records. (* 6)
7. Present lecture on recording the amount owed, payments, and due dates of future payments.
8. Present lecture on vendor credit policy and interest charges.
9. Discuss the importance of keeping back up files for accounts receivable records.
10. Question students on the purpose of invoices, and sales orders.
11. Assign worksheet - Maintain accounts receivable records. (* 7)

CRITERION-REFERENCED MEASURE:

The student must list any inconsistencies between the invoices and the sales orders and record the amount due and payments. All inconsistencies must be recorded and account receivable records must be complete, accurate and legible (test administrator's judgment).

PERFORMANCE GUIDE:

1. Obtain current invoices and order forms.
2. Compare invoices and orders for a specified customer.
3. Record customer's name and account number.
4. Find customer's file.
5. Record amount owed and items purchased.
6. Record amount paid on account.
7. Calculate remaining balance on account.
8. Identify when next payment is due.
9. Log all information on customer's account on back-up file.
10. Place customer's file back in file according to filing system instructions.

VISUAL AID - INVOICE

INV. NO. 001

INVOICE
PRETTY PLACE PARK DISTRICT
PRETTY PLACE, IL

DATE 10/15/88

ACCOUNT TITLE River Park ACCOUNT NO. 56789

VENDOR:

NAME XYZ NURSERY
ADDRESS RR 1
ANYTOWN, IL

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
369	10	2" SUGAR MAPLES	$150.00	$1500.00

SUBTOTAL	$1500.00
TAX	
TOTAL	$1500.00

PRESIDENT, PARK BOARD

DATE

SIGNATURE
FISCAL OFFICER

VISUAL AID - ORDER FORM

ORDER FORM
XYZ NURSERY

REQUISITION NO. 56789-001
REQUISITION DATE 10/15/88

ACCOUNT TITLE River Park ACCOUNT NO. 56789

DELIVER TO CENTRAL RECEIVING
P.P. PARK DISTRICT
1000 N. WALNUT ST.
PRETTY PLACE, IL

DATE REQUIRED 11/1/88

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
369	10	2" SUGAR MAPLES	$150.00	$1500.00

SUBTOTAL	$1500.00
TAX	
TOTAL	$1500.00

VISUAL AID - ACCOUNTS RECEIVABLE RECORDS

ACCOUNTS RECEIVABLE RECORDS
XYZ NURSERY

NAME OF CUSTOMER Pretty Place Park District

Date	Description	debit	credit	balance
8/15	200 ROLLS OF SOD	200.00		200.00
9/15	PAYMENT		200.00	0.00
10/15	10 2" SUGAR MAPLES	1500.00		1500.00

SCHEDULE OF ACCOUNTS RECEIVABLE

Customer	Balance
PRETTY PLACE PARK DISTRICT	1500.00
TOTAL	1500.00

WORKSHEET - MAINTAINING ACCOUNTS RECEIVABLE RECORDS

DIRECTIONS: Using the following invoice and order form, prepare the accounts receivable records for XYZ Nursery.

ACCOUNTS RECEIVABLE RECORDS
XYZ NURSERY

NAME OF CUSTOMER ______________________________

Date	Description	debit	credit	balance

SCHEDULE OF ACCOUNTS RECEIVABLE

Customer	Balance
______________________________	_________
______________________________	_________
______________________________	_________
______________________________	_________
______________________________	_________
TOTAL	=========

WORKSHEET (cont.) - MAINTAINING ACCOUNTS RECEIVABLE RECORDS

INV. NO. 001

INVOICE
PRETTY PLACE PARK DISTRICT
PRETTY PLACE, IL

DATE 10/15/88

ACCOUNT TITLE River Park ACCOUNT NO. 56789

VENDOR:

NAME XYZ NURSERY
ADDRESS RR 1
ANYTOWN, IL

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
369	10	2" SUGAR MAPLES	$150.00	$1500.00

SUBTOTAL	$1500.00
TAX	
TOTAL	$1500.00

PRESIDENT, PARK BOARD

DATE

SIGNATURE
FISCAL OFFICER

WORKSHEET (cont.) - MAINTAINING ACCOUNTS RECEIVABLE RECORDS

ORDER FORM
XYZ NURSERY

REQUISITION NO. 56789-001
REQUISITION DATE 10/15/88

ACCOUNT TITLE River Park
ACCOUNT NO. 56789

DELIVER TO
CENTRAL RECEIVING
P.P. PARK DISTRICT
1000 N. WALNUT ST.
PRETTY PLACE, IL

DATE REQUIRED 11/1/88

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
369	10	2" SUGAR MAPLES	$150.00	$1500.00

SUBTOTAL	$1500.00
TAX	
TOTAL	$1500.00

WORKSHEET ANSWER KEY - MAINTAINING ACCOUNTS RECEIVABLE RECORDS

ACCOUNTS RECEIVABLE RECORDS
XYZ NURSERY

NAME OF CUSTOMER PRETTY PLACE PARK DISTRICT

Date	Description	debit	credit	balance
10/15	10 2" SUGAR MAPLES	1500.00		1500.00

SCHEDULE OF ACCOUNTS RECEIVABLE

Customer	Balance
PRETTY PLACE PARK DISTRICT	1500.00
TOTAL	1500.00 =========

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 12

TASK: Maintain accounts payable records.

STANDARD OF PERFORMANCE OF TASK:

Vendor's invoices, vendor's statements, purchase orders, and/or receiving forms must be reconciled. Cost of order, payment, and payment schedule must be recorded and filed according to specified filing system.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

File system
Orders forms
Receiving forms
Vendor's invoices
Vendor's statements
Accounts payable records

ENABLING OBJECTIVES:

1. File records according to system.
2. Type, print, write or program information on forms.
3. Mark dates on a calendar.
4. Recall meaning of horticultural terms for product size, packaging, and shipping codes.
5. Use calculator to add, subtract, multiply, and/or divide.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Visual aid - Invoice.
5. Visual aid - Order form.

***RESOURCES:** (cont.)

6. Visual aid - Receiving form.
7. Visual aid - Statement of account.
8. Worksheet - Maintaining accounts payable records.

TEACHING ACTIVITIES:

1. Discuss the importance of timeliness and accuracy of records when maintaining accounts payable records.
2. List possible vendors to a horticultural business. (* 1,2 & 3)
3. Show examples of invoices and statements of accounts.
4. Show examples of purchase orders and receiving forms of accounts.
5. Question students regarding the action they would take if they received a bill for something they had not ordered or had not received.
6. Present lecture on reconciling invoices, statements, purchase orders and receiving forms. (* 1,2,3,4,5,6 & 7)
7. Show examples of completed accounts payable records.
8. Present lecture on recording the cost of order, payments applied to order and due dates of future payments.
9. Present lecture on vendor credit policy and interest rates.
10. Discuss the importance of maintaining a good credit rating with vendors.
11. Question students on the purpose of invoices, statement of accounts, purchase orders and/or receiving forms.
12. Assign worksheet - Maintain accounts payable records. (* 8)

CRITERION-REFERENCED MEASURE:

The student must list any inconsistencies between the invoices statements, purchase orders and/or receiving forms, record cost of order and payments. All inconsistencies must be recorded and accounts payable records must be complete, accurate and legible (test administrators's judgment).

PERFORMANCE GUIDE:

1. Obtain vendor's invoices and/or statements.
2. Obtain purchase orders and receiving forms for a specified order.
3. Reconcile invoices, statements, purchase orders, and receiving forms for a specified order:
    - A. Identify any inconsistencies with the shipment.
    - B. Identify any back ordered goods.
4. Record cost of order.
5. Record payments applied to cost of order.
6. Schedule due date for payments.
7. File accounts payable records according to specified file system.

VISUAL AID - INVOICE

INV. NO. 001

INVOICE
XYZ NURSERY
ANYTOWN, IL 21141

DATE 5/15/88

ACCOUNT TITLE Garden Center ACCOUNT NO. 23456

VENDOR:

NAME ABC SUPPLY COMPANY
ADDRESS 414 N. WASHINGTON
ANYTOWN, IL

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
258	100	8" POTS	$0.20	$20.00

SUBTOTAL	$20.00
TAX	1.00
TOTAL	$21.00

PRESIDENT, XYZ NURSERY

DATE

SIGNATURE
FISCAL OFFICER

VISUAL AID - ORDER FORM

ORDER FORM
ABC SUPPLY COMPANY

REQUISITION NO. 23456-001
REQUISITION DATE 5/15/88

ACCOUNT TITLE Garden Center
ACCOUNT NO. 23456

DELIVER TO GARDEN CENTER
XYZ NURSERY
RR 1
ANYTOWN, IL

DATE REQUIRED 6/1/88

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
258	100	8" POTS	$0.20	$20.00

SUBTOTAL	$20.00
TAX	1.00
TOTAL	$21.00

VISUAL AID - RECEIVING FORM

RECEIVING FORM
ABC SUPPLY COMPANY

SHIPPED TO:

COMPANY XYZ NURSERY
CUSTOMER RR 1
DATE ANYTOWN, IL

ITEMS SHIPPED

ITEM#	QUANTITY	UNIT PRICE	DESCRIPTION
258	100	$0.20	8" POTS

BO = BACK ORDERED
OS = OUT OF STOCK
D = DISCONTINUED

VISUAL AID - STATEMENT OF ACCOUNT

STATEMENT OF ACCOUNT
ABC SUPPLY COMPANY

NAME XYZ NURSERY
ADDRESS RR1
ANYTOWN, IL 60611
city state zip

ACCOUNT TITLE GARDEN CENTER ACCOUNT NO 23456

MERCHANDISE PURCHASED

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
258	100	8" POTS	$0.20	$20.00

SUBTOTAL	$20.00
TAX	1.00
TOTAL	$21.00

VISUAL AID - ACCOUNTS PAYABLE RECORDS

ACCOUNTS PAYABLE RECORDS
XYZ NURSERY

NAME OF CREDITOR ______________________________

Date	Description	debit	credit	balance

SCHEDULE OF ACCOUNTS PAYABLE

Creditor	Balance
TOTAL (per balance of controlling account)	=========

WORKSHEET - MAINTAINING ACCOUNTS PAYABLE RECORDS

DIRECTIONS: Prepare the accounts payable records and for the XYZ Nursery company. The XYZ Nursery company purchased supplies from ABC Supply Company. Use the following invoice, order form, receiving form and statement of account for the information needed to complete the accounts payable records.

Be sure to list any discrepancies in regards to items ordered, items received, and items for which the XYZ Nursery company was billed.

ACCOUNTS PAYABLE RECORDS
XYZ NURSERY

NAME OF CREDITOR ______________________________

Date	Description	debit	credit	balance

SCHEDULE OF ACCOUNTS PAYABLE

Creditor	Balance
____________________	________
____________________	________
____________________	________
____________________	________
____________________	________
TOTAL (per balance of controlling account)	=========

WORKSHEET (cont.) - MAINTAINING ACCOUNTS PAYABLE RECORDS

INV. NO. 001

INVOICE
XYZ NURSERY
ANYTOWN, IL 21141

DATE 5/15/88

ACCOUNT TITLE Garden Center ACCOUNT NO. 23456

VENDOR:

NAME ABC SUPPLY COMPANY
ADDRESS 414 N. WASHINGTON
ANYTOWN, IL

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
258	100	8" POTS	$0.20	$20.00

SUBTOTAL	$20.00
TAX	1.00
TOTAL	$21.00

PRESIDENT, XYZ NURSERY

DATE SIGNATURE
FISCAL OFFICER

WORKSHEET (cont.) - MAINTAINING ACCOUNTS PAYABLE RECORDS

ORDER FORM

ABC SUPPLY COMPANY

REQUISITION NO. 23456-001
REQUISITION DATE 5/15/88

ACCOUNT TITLE Garden Center ACCOUNT NO. 23456

DELIVER TO
GARDEN CENTER
XYZ NURSERY
RR 1
ANYTOWN, IL

DATE REQUIRED 6/1/88

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
258	100	8" POTS	$0.20	$20.00

SUBTOTAL	$20.00
TAX	1.00
TOTAL	$21.00

WORKSHEET (cont.) - MAINTAINING ACCOUNTS PAYABLE RECORDS

RECEIVING FORM

ABC SUPPLY COMPANY

SHIPPED TO:

COMPANY	XYZ NURSERY
CUSTOMER	RR 1
DATE	ANYTOWN, IL

ITEMS SHIPPED

ITEM#	QUANTITY	UNIT PRICE	DESCRIPTION
258	50	$0.20	8" POTS
258	50	$0.20	(OS) 8" POTS

BO = BACK ORDERED
OS = OUT OF STOCK
D = DISCONTINUED

WORKSHEET (cont.) - MAINTAINING ACCOUNTS PAYABLE RECORDS

STATEMENT OF ACCOUNT

ABC SUPPLY COMPANY

NAME XYZ NURSERY
ADDRESS RR1
ANYTOWN, IL 60611
city state zip

ACCOUNT TITLE GARDEN CENTER ACCOUNT NO 23456

MERCHANDISE PURCHASED

ITEM#	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
258	150	8" POTS	$0.20	$30.00

SUBTOTAL	$30.00
TAX	1.50
TOTAL	$31.50

WORKSHEET ANSWER KEY - MAINTAINING ACCOUNTS PAYABLE RECORDS

Discrepancies:

1. XYZ Nursery ordered 100 8" pots, however they only received 50 8" pots. 50 8" pots were out of stock.
2. XYZ Nursery received 50 8" pots, however they were billed for 150 8" pots.

ACCOUNTS PAYABLE RECORDS
XYZ NURSERY

NAME OF CREDITOR ABC SUPPLY COMPANY

Date	Description	debit	credit	balance
5/15	50 8" POTS @$0.20, 5% tax	$10.50		$10.50

SCHEDULE OF ACCOUNTS PAYABLE

Creditor	Balance
ABC SUPPLY COMPANY	10.50
TOTAL (per balance of controlling account)	10.50

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 13

TASK: Maintain fiscal balance sheet records.

STANDARD OF PERFORMANCE OF TASK:

Assets and liabilities must be calculated and recorded without error.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Fiscal files
Production files
Fiscal balance sheet form

ENABLING OBJECTIVES:

1. Use a calculator to add, subtract, multiply and/or divide.
2. File records according to a system.
3. Send document to agency.

***RESOURCES:**

1. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
2. Sullivan, Robertson, & Staby. (1980). Management for retail florists with applications. Fort Worth, TX: Branch-Smith Publishing
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Visual aid - Balance sheet.
5. Checklist - Maintaining fiscal balance sheet records.

TEACHING ACTIVITIES:

1. Question students on the definition of fiscal.
2. Present lecture on reasons for maintaining fiscal balance sheet records. (* 1,2 & 3)

TEACHING ACTIVITIES: (cont.)

3. Discuss the importance of accuracy when completing a balance sheet.
4. Present lecture on parts of a balance sheet.
5. List records used to gather information needed to complete balance sheet.
6. Present lecture on types of assets. (* 1,2 & 3)
7. Present lecture on types of liabilities. (* 1,2 & 3)
8. Present lecture on types of equity. (* 1,2 & 3)
9. Present lecture on calculating net worth. (* 1,2 & 3)
10. Present lecture on recording information on to a balance sheet. (* 4)
11. Discuss the importance of updating financial records.
12. Assign each student a list of assets, liabilities and equity for which to complete a balance sheet. (* 5)

CRITERION-REFERENCED MEASURE:

The student must record the total amount of each of the following: long term, intermediate and current assets; long term, intermediate and current liabilities; common stock, paid-in capital, and retained earnings, calculate the net worth and file a copy of the fiscal balance sheet. The recorded totals must be correct, all information recorded on the balance sheet must be in the correct location, and legible (test administrator's judgment).

PERFORMANCE GUIDE:

1. Obtain specified balance sheet forms.
2. Gather fiscal and production files.
3. Complete the fiscal balance sheet:
    A. Calculate assets:
        1. Long term.
        2. Intermediate.
        3. Current.
    B. Calculate liabilities:
        1. Long term.
        2. Intermediate.
        3. Current.
    C. Calculate equity.

PERFORMANCE GUIDE: (cont.)

4. Calculate net worth by subtracting liabilities from assets.
5. File copy of the fiscal balance sheet.
6. Send copy of fiscal balance sheet to agency or financial institution requesting it.
7. Update fiscal sheet periodically.
   NOTE: Fiscal sheet should be updated on at least a yearly basis.

VISUAL AID - BALANCE SHEET

XYZ NURSERY
BALANCE SHEET
DECEMBER 31, 19X1

ASSETS

CURRENT ASSETS:			
Cash			25,000
Marketable Securities			13,000
Notes Receivable			30,000
Accounts Receivable			70,000
Inventory			100,000
Prepaid Expenses			12,000
total current assets			250,000
PROPERTY, PLANT, & EQUIPMENT: (long-term)			
Land		60,000	
Building	140,000		
Less: Accumulated Depreciation	56,000	84,000	
Store Equipment	24,000		
Less: Accumulated Depreciation	18,000	6,000	
Delivery Equipment	19,000		
Less: Accumulated Depreciation	10,000	9,000	
total property, plant, & equipment			159,000
OTHER ASSETS:			
Land (future bldg site)			125,000
Total Assets			534,000

LIABILITIES & STOCKHOLDER'S EQUITY

LIABILITIES

CURRENT LIABILITIES:	
Notes Payable (due 6 months)	15,000
Accounts Payable	59,900
Accrued Expense Payable	14,100
Unearned Revenue	11,000
total current liabilities	100,000
LONG-TERM LIABILITIES:	
Mortgage Payable	108,500
Total Liabilities	208,500

STOCKHOLDER'S EQUITY

Common Stock	200,000	
Paid-In Capital	100,000	
Retained Earnings	25,500	
total stockholder's equity		325,500
		534,000
Total Liabilities & Stockholder's Equity		=======

CHECKLIST

DUTY Performing Administrative Functions

TASK Maintain fiscal balance sheet records.

ENABLER

1. Use a calculator to add, subtract, multiply and/or divide.
2. File records according to a system.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain fiscal balance sheet records.

PERFORMANCE DETERMINANTS	YES	NO
1. Recorded total amount of:		
- Long term assets.	______	______
- Intermediate assets.	______	______
- Current assets.	______	______
- Long term liabilities.	______	______
- Intermediate liabilities.	______	______
- Current liabilities.	______	______
- Common stock.	______	______
- Paid-in capital.	______	______
- Retained earnings.	______	______
2. Recorded total of assets.	______	______
3. Recorded total of liabilities.	______	______
4. Calculated net worth.	______	______
5. Filed records.	______	______

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 14

TASK: Employ business personnel.

STANDARD OF PERFORMANCE OF TASK:

A job description must be developed and advertised, and job criteria determined for a business position. The most qualified applicant for the business position must be selected after reviewing applications and interviewing applicants.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Applicants
Job applications
List of business tasks performed

ENABLING OBJECTIVES:

1. Recall the requirements (knowledge, skills, attitudes) required to perform the tasks of the business position.
2. Recall advertising media and methods available.
3. Compose written advertisement.

***RESOURCES:**

1. American Nurseryman Publishing Co. _Preparation guide for a job description manual_ [pamphlet]. Chicago, IL: Author.
2. Garden Centers of America. _Interviewing and hiring employees_ [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
3. American Nurseryman Publishing Co. _New employee orientation manual_ [pamphlet]. Chicago, IL: Author.
4. American Nurseryman Publishing Co. _Equal employment opportunity_ [pamphlet]. Chicago, IL: Author.
5. American Nurseryman Publishing Co. _Partners for profit advertising manual_ [pamphlet]. Chicago, IL: Author.

***RESOURCES: (cont.)**

6. American Nurseryman Publishing Co. (1977). Operating an effective advertising program. Chicago, IL: Author.
7. American Nurseryman Publishing Co. Newspaper advertising summary [pamphlet]. Chicago, IL: Author.
8. American Nurseryman Publishing Co. Radio advertising summary [pamphlet]. Chicago, IL: Author.
9. American Nurseryman Publishing Co. Guide to effective advertising [pamphlet]. Chicago, IL: Author.
10. Checklist - Employing business personnel.

TEACHING ACTIVITIES:

1. Question students on how they believe most people get jobs.
2. Discuss the importance of hiring the most qualified applicant.
3. List business tasks performed by horticultural business employees.
4. Present lecture on what should be included in a job description. (* 1,2,3,4,5,6, & 7)
5. Present lecture on development of criteria to be used in selecting new employees. (* 1,2 & 4)
6. List criteria to be used in selecting new employees.
7. Question students on advertising media and methods available. (* 5,6,7,8 & 9)
8. Present lecture on evaluation of job applications based on predetermined criteria. (* 2)
9. Question students on what questions they would ask an applicant during an interview. (* 2)
10. Question students on what questions they would ask an applicants references. (* 2)
11. Present lecture on information provided to applicant during the interview. (* 2)
12. Present lecture on avoiding selection of new employees based on anything other than the predetermined criteria. (* 3)
13. Assign each student a list of business tasks for which to plan the employee selection process. (* 10)

CRITERION-REFERENCED MEASURE:

The student must develop a job description, list criteria used to select new employee and list questions for the applicant and the applicant's references. The job description must summarize the tasks to be performed the criteria must be related to the tasks and the listed questions must be relevant (test administrator's judgment).

PERFORMANCE GUIDE:

1. Evaluate business tasks to be performed.
2. Develop a job description for the business position.
3. Identify criteria needed by applicant to perform tasks.
4. Advertise the available position.
5. Review job applications for required criteria.
6. Check applicant's work experience and references.
7. Interview applicants which best meet the job criteria:
    A. Discuss applicant's education and work experience.
    B. Discuss applicant's interest in job and business field.
    C. Explain the duties and responsibilities of the position.
    D. Discuss salary and benefits.
8. Assess qualifications of applicants.
9. Select applicant that is most qualified for the advertised position.

CHECKLIST

DUTY Performing Administrative Functions

TASK Employ business personnel.

ENABLER

1. Recall the requirements (knowledge, skills, attitudes) required to perform the tasks of the business position.
2. Recall advertising media and methods available.
3. Compose written advertisement.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to employ business personnel.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Grouped horticultural business tasks according to similarities.	______	______
2.	Summarized the list in 50 words or less.	______	______
3.	Composed newspaper advertisement in 25 words or less.	______	______
4.	Listed criteria for applicants.	______	______
5.	Listed questions for applicant during interview.	______	______
6.	Listed questions for references.	______	______
7.	Listed information to be provided to applicant during interview.	______	______

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 15

TASK: Train employees.

STANDARD OF PERFORMANCE OF TASK:

Training plan must be developed for employees and reflect employee's needs. Method of training for each specific task must be selected and include demonstrations, use of reference materials, visitations, and formal instruction.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Employee
Other businesses
Training material
Formal instruction
Reference materials

ENABLING OBJECTIVES:

1. Supervise employees.

***RESOURCES:**

1. American Association of Nurserymen. Talking over foremanship [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
2. American Nurseryman Publishing Co. New employee orientation manual [pamphlet]. Chicago, IL: Author.
3. American Nurseryman Publishing Co. Equal employment opportunity [pamphlet]. Chicago, IL: Author.
4. Checklist - Training employees.

TEACHING ACTIVITIES:

1. Question students on their opinion of the importance of training employees.
2. Discuss the importance of training to employee safety, productivity and job satisfaction. (* 1,2 & 3)

TEACHING ACTIVITIES: (cont.)

3. Question students on business personnel who provide training.
4. Question students on when employees should be trained.
5. Present lecture on references available to help train employees. (* 1,2 & 3)
6. List the tasks required to perform a horticultural job.
7. Present lecture on defining tasks in terms of objectives.
8. Present lecture on dividing tasks into steps.
9. Demonstrate how to perform a task at a rate that an inexperienced person can follow
10. Present lecture on wait time following questioning.
11. Present lecture on advantages of having a trainee observe other workers.
12. Present lecture on the benefits of formal training.
13. List sources of formal training.
14. Assign each student a task for which to prepare and present a training demonstration. (* 4)

CRITERION-REFERENCED MEASURE:

The student must list the steps of the task, the objective of the task, the training materials to be used, and safety or other special considerations for performance of the task, demonstrate the task and evaluate the trainees performance of the task. The list of steps must be complete and in order (if applicable), the objective must be measurable (test administrator's judgment), and all safety considerations must be listed. The demonstration must include all steps, all safety considerations, allow for trainee questions and review important steps until the trainee can complete the task without help.

PERFORMANCE GUIDE:

1. Identify tasks employees must yet master in order to be proficient at their job.
2. Develop employee training plan:
    - A. List tasks that the employee needs to master.
    - B. List person to provide training.
    - C. List when training will occur.
3. Train employees for each specific task:
    - A. Demonstrate the task:
        1. Collect training materials.
        2. Explain objectives, methods, and safety precautions to employee.

PERFORMANCE GUIDE: (cont.)

3. Perform the task:
   a. Explain each step
   b. Encourage employe
4. Observe employee perfo
5. Ask employee questions
   employee's understandi
6. Critique employee's pe
7. Repeat demonstration i
8. Supervise employee unt

B. Recommend reference materi
1. Specialized textbooks.
2. Trade journals.
3. Extension publications
4. Manuals.

C. Plan visitation to other
1. Observe techniques.
2. Ask questions.

D. Receive formal instructio
1. Meetings of professio
2. Seminars.
3. Workshops.
4. Course.
5. Tour.

e task:
n each step as task is performed.
ge employee to ask questions.
loyee performing the task.
e questions to evaluate
understanding of task.
ployee's performance.
nstration if necessary.
mployee until skill is mastered.
ence material to employee:
textbooks.
als.
ublications.

to other businesses:
hniques.
ns.
instruction:
professional organizations.

CHECKLIST

DUTY Performing Administrative Functions

TASK Train employees.

ENABLER

1. Supervise employees.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to train employees.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Listed the steps of the task.		
2.	Listed measurable objectives for the task.		
3.	Listed training materials to be used.		
4.	Listed safety consideration when completing the task.		
5.	Demonstrated the task at an appropriate rate.		
6.	Demonstrated safety precautions to take.		
7.	Allowed time for trainee's questions.		
8.	Answered trainee's questions.		
9.	Observed trainee's performance of the task.		
10.	Evaluated trainee's performance according to listed objectives.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 16

TASK: Evaluate employee performance.

STANDARD OF PERFORMANCE OF TASK:

Evaluation form must be completed, signed by evaluator and employee, and processed and filed according to company's guidelines.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Employee
Employee's file
Position description
Employee evaluation form

ENABLING OBJECTIVES:

1. Print, write or type information on evaluation form.
2. Recall employee's performance of tasks.
3. Recall company standards.

***RESOURCES:**

1. American Nurseryman Publishing Co. Talking over foremanship [pamphlet]. Chicago, IL: Author.
2. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Checklist - Evaluating employee performance.

TEACHING ACTIVITIES:

1. Question students on their opinion of the importance of evaluating employees.
2. Discuss the importance of remaining objective when evaluating employees.
3. List several tasks with which the students are familiar. (* 2,3 & 4)
4. Question students on things they would look for when rating an employee's performance of the listed tasks.
5. Present lecture on other things, positive and negative, that effect the employee's evaluation. (* 1)
6. Present lecture on summarizing the evaluation into comments and recommendations.
7. Discuss the importance of discussing the evaluation with the employee.
8. Assign each student a task or job description for which to list evaluation criteria and evaluate an employee's performance. (* 5)

CRITERION-REFERENCED MEASURE:

The student must list the evaluation criteria for the task or job description. The listed evaluation criteria must be complete (test administrator's judgment).

PERFORMANCE GUIDE:

1. Review employee's file for memos, written warnings, and evidence of continuing education.
2. Obtain a company evaluation form.
3. Record the tasks that must be performed by the employee on the evaluation form.
4. Rate employee's performance of specified tasks according to company's standards:
   A. Average.
   B. Above average.
   C. Below average.
5. Record any comments and recommendations for employee improvement.
6. Discuss evaluation with the employee.
7. Sign evaluation.
8. Request the employee's signature.
9. Give the employee a copy of the completed evaluation.
10. File a copy of the completed evaluation in the departmental files.
11. Submit the completed evaluation to appropriate person/department.

CHECKLIST

DUTY Performing Administrative Functions

TASK Evaluate employee performance.

ENABLER

1. Print, write or type information on evaluation form.
2. Recall employee's performance of tasks.
3. Recall company standards.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to evaluate employee performance.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Listed the tasks that must be performed by the employee.		
2.	Rated employee's performance of specified tasks.		
3.	Listed any comments and recommendations for employee improvement.		
4.	Discussed evaluation with the employee.		
5.	Signed evaluation.		
6.	Requested the employee's signature.		
7.	Gave the employee a copy of the completed evaluation.		
8.	Filed a copy of the completed evaluation in the departmental files.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 17

TASK: Dismiss employees.

STANDARD OF PERFORMANCE OF TASK:

Reasons for dismissal must be documented. The employee must be privately informed about the dismissal, the date dismissal is effective, and the reasons for the dismissal.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Employee
Employee file

ENABLING OBJECTIVES:

1. Read employee's file.
2. Recall regulations regarding equal opportunity employment.
3. File records according to system.

***RESOURCES:**

1. American Association of Nurserymen. Talking over foremanship [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
2. American Nurseryman Publishing Co. Equal employment opportunity [pamphlet]. Chicago, IL: Author.
3. Garden Centers of America. Interviewing and hiring employees [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
4. Garden Centers of America. (1987). Garden center policy manual [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
5. American Nurseryman Publishing Co. New employee orientation manual [pamphlet]. Chicago, IL: Author.
6. Employees's files.
7. Checklist - Dismissing employees.

TEACHING ACTIVITIES:

1. List reasons why people are dismissed from jobs.
2. Discuss the importance of documenting the reason's for dismissal. (* 1,2,3,4 & 5)
3. Show examples of employee files. (* 6)
4. Discuss the importance of respecting the employee's privacy.
5. List the information that should be provided to the employee when they are informed of the dismissal.
6. Question students on how they would verbally inform the employee about the dismissal.
7. Discuss the student's suggestion for verbally informing the employee about the dismissal.
8. Assign each student a employee file for which to document the reason for dismissal.
9. Assign student's to play the role of a supervisor informing an employee of their dismissal. (* 7)

CRITERION-REFERENCED MEASURE:

The student must read the employee's file, record the reasons for dismissal, and verbally inform the employee (role playing) of the dismissal. The documentation for the reasons for dismissal must include all infractions of company policy listed in the employee's file and the verbal notification of the dismissal must be private, provide the reasons for dismissal and the date the dismissal is effective.

PERFORMANCE GUIDE:

1. Identify the employee to be dismissed.
2. Document reasons for dismissal.
3. Meet privately with the employee:
   A. Inform employee that he/she is being dismissed.
   B. Inform employee the date dismissal is effective.
   C. Explain reasons for dismissal to the employee.
4. File the date of employee dismissal and reasons for dismissing employee in the particular employee's file.

CHECKLIST

DUTY Performing Administrative Functions

TASK Dismiss employees.

ENABLER

1. Read employee's file.
2. Recall regulations regarding equal opportunity employment.
3. File records according to system.

STUDENT'S NAME ____________________ **DATE** __________

EVALUATOR'S NAME ____________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to dismiss employees.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Recorded the employees name.	____	____
2.	Listed reasons for dismissal:		
	- Disciplinary.	____	____
	- Lower labor requirements (layoff).	____	____
	- Company policy.	____	____
	- Apprenticeships.	____	____
3.	Assured employee that meeting is private.	____	____
4.	Informed employee that he/she is being dismissed.	____	____
5.	Informed employee the date dismissal is effective.	____	____
6.	Explained listed reasons for dismissal to the employee.	____	____
7.	Filed the date of employee dismissal and reasons for dismissing employee in the employee's file.	____	____

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 18

TASK: Prepare state and federal reports.

STANDARD OF PERFORMANCE OF TASK:

State and federal reports for particular business operations must be identified, completed, and processed without error.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Employee records
Business records
Plant production records
Required state and federal forms

ENABLING OBJECTIVES:

1. Type or print information on forms.
2. File records according to system.
3. Use calculator to add, subtract, multiply and/or divide.

***RESOURCES:**

1. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
2. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Tax booklets, available from federal, state and local taxing agencies.
5. Government releases, available from regulatory agencies.
6. Checklist - Preparing state and federal reports.

TEACHING ACTIVITIES:

1. Question students on federal and state tax forms they have filled out in the past.
2. Present lecture on reasons why business operators are required to complete state and federal forms. (* 1,2 & 3)
3. List reports and their filing dates required by state and federal agencies.
4. Present lecture on business records used to complete the listed reports.
5. Present lecture on services provided by accountants.
6. Present lecture on obtaining a federal employee identification number and/or a sales tax number.
7. Show examples of forms needed to file reports. (* 4 & 5)
8. Show parts of individual forms. (* 4 & 5)
9. Present lecture on sources of information used to complete forms.
10. Discuss the importance of completing the forms accurately and legibly.
11. Assign each student a form to complete. (* 6)

CRITERION-REFERENCED MEASURE:

The student must collect the business records required to complete the form and print or type all required information on the form. The completed form must be accurate and legible (test administrator's judgment).

PERFORMANCE GUIDE:

1. Identify required state and/or federal reports applicable to current business operation:
   A. Required state reports:
      1. Income tax.
      2. Workman's compensation.
      3. Unemployment.
      4. Environmental Protection Agency (EPA).
      5. Department of Agriculture.
      6. Sales tax.
   B. Required federal reports:
      1. Income tax.
      2. Federal Insurance Contributions Act (FICA).
      3. United States Department of Agriculture (USDA).
      4. Interstate Commerce Commission.

PERFORMANCE GUIDE: (cont.)

2. Obtain required forms needed to file reports.
3. Gather the information needed to complete the forms.
4. Complete the forms on a timely basis.
5. Send report forms to the specified agency.
6. File a copy of the report according to specified file system.

CHECKLIST

DUTY Performing Administrative Functions

TASK Prepare state and federal reports.

ENABLER

1. Type or print information on forms.
2. File records according to system.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare state and federal reports.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Gathered the information needed to complete the forms.	________	________
2.	Collected requested information.	________	________
3.	Entered legible information.	________	________
4.	Performed needed addition and subtraction.	________	________
5.	Sent report forms to the specified agency.	________	________
6.	Filed a copy of the report.	________	________

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 19

TASK: Maintain trade organization certification.

STANDARD OF PERFORMANCE OF TASK:

The horticultural business must meet the specified standards of the trade organization. Renewal application and fee must be submitted to the trade organization by their due date.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Renewal payment
Renewal application
Trade organization requirements

ENABLING OBJECTIVES:

1. Write a check.
2. Print or type information on an application.
3. Determine if trade organization standards are being met.

***RESOURCES:**

1. Uchtmann, D., Looney, J., Krausz & Hannah. (1981). Agricultural law: Principles and cases. Manchester, MO: McGraw-Hill Book Co.
2. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
4. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
5. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
6. Trade organization standards.

***RESOURCES:** (cont.)

7. Trade organization application.
8. Checklist - Maintaining trade organization certification.

TEACHING ACTIVITIES:

1. Present lecture on advantages and disadvantages of trade organizations to a horticulture business. (* 1,2,3,4 & 5)
2. List trade organizations.
3. List standards of trade organizations. (* 6)
4. Question students regarding business practices that do and/or do not meet trade organization standards.
5. Present lecture on horticulture trade organization certification requirements. (* 6)
6. Show example of horticulture trade organization application. (* 7)
7. Demonstrate how to complete a horticulture trade organization application. (* 7)
8. Assign each student a trade organization application to complete. (* 8)

CRITERION-REFERENCED MEASURE:

The student must identify business practices that do not meet the specified standards of the trade organization, print or type the requested information on the trade organization application and write a check for the trade organization renewal fee. The trade organization application must be completed (100% of requested information provided) and a check must be written for the exact amount of renewal fee (check is cashable).

PERFORMANCE GUIDE:

1. Obtain requirements for trade organization certification.
2. Support the specified horticultural business standards required by the specific trade organization.
3. Renew trade certification application as required by specific trade organization.
4. Pay trade certification renewal fee when due.

CHECKLIST

DUTY Performing Administrative Functions

TASK Maintain trade organization certification.

ENABLER

1. Write a check.
2. Print or type information on an application.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain trade organization certification.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified trade organization renewal application.	______	______
2. Printed or typed all requested information on the renewal application.	______	______
3. Identified amount of trade organization renewal fee.	______	______
4. Wrote check for amount of trade organization renewal fee.	______	______
5. Mailed renewal application and check to trade organization.	______	______

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 20

TASK: Supervise employees.

STANDARD OF PERFORMANCE OF TASK:

Employee must be observed performing assigned tasks from daily work assignment. Employee's performance must be critiqued according to established company standards.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Daily work schedule
Company work standards
Employee (performing tasks)

ENABLING OBJECTIVES:

1. Recall how work assignments are performed.
2. Recall the safety procedures to follow on the work assignment.
3. Recall company standards.

***RESOURCES:**

1. American Association of Nurserymen. Talking over foremanship [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
2. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Checklist - Supervising employees.

TEACHING ACTIVITIES:

1. Question students on their opinion of the importance of supervision on the job.
2. Discuss the importance of the supervisor's role in maintaining a safe, productive work environment. (* 1)
3. List several tasks with which the students are familiar. (* 2,3 & 4)
4. Question students on the things they would look for when critiquing the performance of the listed tasks.
5. Discuss the importance of discussing the critique with the employee.
6. Discuss the importance of listening to the employee's concerns and suggestions.
7. Assign each student a task for which to list performance criteria, observe the performance of the task and list items to be discussed with employee. (* 5)

CRITERION-REFERENCED MEASURE:

The student must list items to be critiqued, observe the performance of the task, and list items to be discussed with the employee. The list of items to be critiqued, and the list of items to be discussed with the employee must be complete (test administrator's judgment).

PERFORMANCE GUIDE:

1. Provide employee with his/her daily work assignments.
2. Observe employee performing assigned tasks.
3. Inspect employee's performance.
4. Critique the employee's performance on established company standards:
    - A. Follows instructions.
    - B. Follows standard horticultural practices.
    - C. Selects and uses correct tools.
    - D. Observes safety procedures.
    - E. Cleans work area.
    - F. Completes task in reasonable amount of time.
5. Discuss with employee:
    - A. Ways performance can be improved.
    - B. Tasks that are being performed well.

CHECKLIST

DUTY Performing Administrative Functions

TASK Supervise employees.

ENABLER

1. Recall how work assignments are performed.
2. Recall the safety procedures to follow on the work assignment.
3. Recall company standards.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to supervise employees.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Listed performance criteria for task.		
2. Observed employee performing assigned tasks.		
3. Inspected employee's performance.		
4. Critiqued the employee's performance on established company standards:		
- Followed instructions.		
- Followed standard horticultural practices.		
- Selected and used correct tools.		
- Observed safety procedures.		
- Cleaned work area.		
- Completed task in reasonable amount of time.		

PERFORMANCE DETERMINANTS (cont.)	**YES**	**NO**
5. Discussed with employee:		
- Ways performance could be improved.	________	________
- Tasks that were being performed well.	________	________

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 21

TASK: Maintain employee benefit records.

STANDARD OF PERFORMANCE OF TASK:

Employee benefit records must include all information required on particular benefit form, benefits earned, and record of payment. Employee benefit records must be filed in accordance with filing system.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Benefit forms
Employee's benefit files

ENABLING OBJECTIVES:

1. File records according to system.
2. Print or type requested information on benefit form.
3. Identify the benefits for which an employee is eligible.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Employee's rights [poster]. Department of Labor.
5. Benefit form.
6. Checklist - Maintaining employee's benefit records.

TEACHING ACTIVITIES:

1. Discuss the importance of maintaining employee benefit records. (* 2,3 & 4)
2. List all benefits for which an employee may be eligible. (* 2,3 & 4)
3. List factors that effect the benefits that an employee can receive. (* 4)
4. Question students on determining the benefits for which an employee is eligible.
5. Show examples of benefit forms. (* 5)
6. Show parts of a benefit form. (* 5)
7. Demonstrate how to fill out the benefit form. (* 5)
8. Question students on how to file the employee's benefit records.
9. Monitor students as they practice filling out employee benefit forms.
10. Assign each student an employee benefit form to complete. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the benefits that the employee receives, calculate the amount of each benefit, complete the employee benefit form and file the employee benefit records. All benefits that the employee should receive and only the benefits that the employee should receive must be listed, all calculations must be accurate to one decimal place, all data must be recorded on the benefit form and the employee records must be filed.

PERFORMANCE GUIDE:

1. Identify the benefits that employees receive at specified business:
   A. FICA.
   B. Workman's compensation.
   C. Unemployment compensation.
   D. Insurance.
   E. Vacation.
   F. Pension.
   G. Employee discount.

PERFORMANCE GUIDE: (cont.)

2. Obtain required benefit record keeping forms.
3. Complete benefit record keeping forms:
    - A. Identify employee.
    - B. Provide information required on particular benefit form.
    - C. Calculate benefits earned.
    - D. Record payments made by company.
    - E. Record date next benefit payment is due.
4. File benefit records according to specified file system.

CHECKLIST

DUTY Performing Administrative Functions

TASK Maintain employee benefit records.

ENABLER

1. File records according to system.
2. Print or type requested information on benefit form.
3. Identify the benefits for which an employee is eligible.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain employee benefit records.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed the benefits that the employee receives.	______	______
2. Calculated the amount of each benefit.	______	______
3. Completed the employee benefit form.	______	______
4. Filed the employee benefit records.	______	______

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 22

TASK: Estimate labor requirements.

STANDARD OF PERFORMANCE OF TASK:

The number of permanent and seasonal employees, full and part-time, must be estimated for each functional unit of the business. The person hours required to complete the job must equal the estimate.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Sales projections
Production schedules
Previous years work records

ENABLING OBJECTIVES:

1. Read production schedules and work records.
2. Recall amount of time required to perform tasks in horticultural business.
3. Use calculator to add, subtract, multiply and/or divide.

***RESOURCES:**

1. American Association of Nurserymen. _Talking over foremanship_ [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.
2. Sullivan, Robertson, & Staby. (1980). _Management for retail florists with applications_. Fort Worth, TX: Branch-Smith Publishing.
3. Davidson, H., & Mecklenburg, R. (1981). _Nursery management administration and culture_. Englewood Cliffs, NJ: Prentice Hall.
4. Berninger, L. (1981). _Profitable garden center management_. Chicago, IL: American Nurseryman Publishing Co.
5. Kooi, C. (1985). _Estimating and management principles for landscape contractors_. Chicago, IL: American Nurseryman Publishing Co.

***RESOURCES:** (cont.)

6. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
7. Production schedules.
8. Previous years work records.
9. Sales projections.
10. Checklist - Estimating labor requirements.

TEACHING ACTIVITIES:

1. Discuss the importance of having enough employees, yet not too many. (* 1 & 2)
2. List business records used when determining labor needs. (* 7,8 & 9)
3. List types of horticultural businesses.
4. Present lecture on the times of the year, week and day when labor requirements are highest for the listed horticultural businesses.
5. List the tasks performed at the listed horticultural businesses. (* 3,4,5 & 6)
6. Question students on how they would group the employee's into functional units and/or work crews.
7. Question students on the time of the year, week and day when the labor requirements are highest for each of the functional units of the business.
8. Present lecture on a hypothetical business' production schedules.
9. Question students on the functional units of the hypothetical business.
10. Question students on the busiest time of the year, week and day for each functional unit of the hypothetical business.
11. Question students on the labor requirements of the functional units of the hypothetical business.
12. Assign students to total the labor requirements of the hypothetical business.
13. Assign each student a production schedule for which to estimate labor requirements. (* 10)

CRITERION-REFERENCED MEASURE:

The student must list the times of the year, week or day that labor requirements are highest, list the tasks to be performed to meet the deadlines of the production schedule, divide the labor force into functional units and/or crews and record the labor requirements of each functional unit and the total labor required to meet the deadlines of production schedule. The listed tasks must be

CRITERION-REFERENCED MEASURE: (cont.)

complete (test administrator's judgment). The recorded labor requirements of the functional units and the total labor requirement must be sufficient to meet the deadlines of the production schedule (test administrator's judgment).

PERFORMANCE GUIDE:

1. Estimate projected business volume for the upcoming season:
   A. Check previous years' work records.
   B. Review upcoming production schedule and sales projections.
2. Divide job areas into functional units:
   A. Estimate the skill required to perform the upcoming jobs.
   B. Identify the number of person hours required by each functional unit to complete estimated jobs.
3. Project the number of permanent and seasonal employees, full and part-time, required in each functional unit:
   A. Identify busiest times during the season.
   B. Identify busiest times during the week.
   C. Identify busiest time during the day.
4. Add the number of estimated employees in each functional unit to project the total number of needed employees.

CHECKLIST

DUTY Performing Administrative Functions

TASK Estimate labor requirements.

ENABLER

1. Read production schedules and work records.
2. Recall amount of time required to perform tasks in horticultural business.
3. Use calculator to add, subtract, multiply and/or divide.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to estimate labor requirements.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed the times of the year that labor requirements are highest.	_______	_______
2. Listed the times of the week that labor requirements are highest.	_______	_______
3. Listed the times of the day that labor requirements are highest.	_______	_______
4. Divided employee's into functional units.	_______	_______
5. Listed the skill required to perform the upcoming jobs.	_______	_______
6. Listed the number of employee hours required by each functional unit to complete estimated jobs.	_______	_______
7. Listed the number of permanent and seasonal employees, full and part-time, required in each functional unit:	_______	_______
8. Totaled the labor requirements.	_______	_______

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 23

TASK: Plan plant production schedules.

STANDARD OF PERFORMANCE OF TASK

The plant production schedule must consist of needed cultivars, estimated number of plants needed for sale, date of sale, planting date, estimated crop loss percentage, and growing space needed. The plant date, estimated crop loss, and space crop will occupy must be calculated.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop production manual
Current year's sales projections
Previous years' production records

ENABLING OBJECTIVES:

1. Recall plant names, sizes, container types.
2. Look up recommended production requirements.
3. Use calculator to add, subtract, multiply and/or divide.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
3. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.
4. Cooperative Extension, Cornell University. (1981). Cornell recommendations for commercial floriculture crops part 1: Cultural practices and production programs. Ithaca, NY: Author.
5. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.

***RESOURCES:** (cont.)

6. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
7. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
8. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
9. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
10. Krussman, G. (1985). Manual of cultivated broad leaved trees and shrubs (Vol. 3). Fort Worth, TX: Branch-Smith Publishing.
11. Retail/wholesale plant catalogs.
12. Production records.
13. Plant production schedule.
14. Checklist - Planning plant production schedules.

TEACHING ACTIVITIES:

1. Discuss the importance of planning plant production.
2. List horticultural crops. (* 1,2,3,4,5,6,7,8,9,10,11 & 12)
3. Question students on demand for the listed horticultural crops.
4. List resources available for helping to determine demand for the horticultural crop. (* 1,2,3,4,5,6,7,8,11 & 12)
5. List factors to consider when estimating demand for the horticultural crop. (* 1,2,3,4,5,6,7,8,11 & 12)
6. Present lecture on estimating demand for the horticultural crop. (* 1,2,3,4,5,6,7,8,11 & 12)
7. Question student on the time of year that the listed horticultural crops are sold. (* 1,2,3,4,5,6,7 & 8)
8. Question students on the length of time required to produce the horticultural crops.
9. Present lecture on determining the planting date for the horticultural crop.
10. Present lecture on estimating crop loss. (* 1,2,3,4,5,6,7,8,9,10 & 12)
11. List factors to consider when determining the spacing for a horticultural crop.

TEACHING ACTIVITIES: (cont.)

12. Show an example of a plant production schedule. (* 13)
13. Assign students to calculate the space requirement of a horticultural crop.
14. Assign each student a plant production facility for which to plant the plant production schedule. (* 14)

CRITERION-REFERENCED MEASURE:

The student must select and describe the horticultural crops to be grown including plant names, number of each plant to be produced, size of plant when sold and calculate the planting date, the number of plantlets needed to start the crop and the space needed to produce the crop. The student must explain and/or site references regarding the reasons for selection of the crop, the planting date, number of plantlets needed and space needed.

PERFORMANCE GUIDE:

1. Estimate demand for plant material:
   A. Consult records from previous years.
   B. Consult current year's sales projections.
   C. Consider environmental factors.
   D. Consider current economic and purchasing trends.
2. Identify the needed cultivars, the number of plants per specific cultivar needed, and the date of sale.
3. Identify length of time needed to produce crop from plantlet stage.
4. Calculate plant date by the following formula: Date of sale - crop growing time = plant date.
5. Calculate number of plantlets needed for planting:
   A. Calculate expected percentage of crop loss.
   B. Subtract estimated crop loss percentage from 100% to obtain crop success percentage.
   C. Calculate number of plantlets needed by the following formula: Number of needed plants for sale divided by crop success percentage = number of needed plantlets.
6. Calculate amount of space crop will occupy by using the following formula: Number of plantlets divided by desired spacing (number of plantlets per square foot) = total square feet of growing space.

CHECKLIST

DUTY Performing Administrative Functions

TASK Plan plant production schedules.

ENABLER

1. Recall plant names, sizes, container types.
2. Look up recommended production requirements.
3. Use calculator to add, subtract, multiply and/or divide.

STUDENT'S NAME____________________ **DATE**__________

EVALUATOR'S NAME____________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plan plant production schedules.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Listed the needed cultivars.		
2.	Listed the number of plants per specific cultivar needed.		
3.	Listed the date of sale.		
4.	Listed length of time needed to produce crop from plantlet stage.		
5.	Calculated plant date.		
6.	Listed the expected percentage of crop loss.		
7.	Calculated number of plantlets needed for planting.		
8.	Listed amount of space crop will occupy.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 24

TASK: Plan plant propagation schedules.

STANDARD OF PERFORMANCE OF TASK:

The plant propagation schedules must consist of the needed cultivars, the estimated number of propagules needed, number of plantlets needed, the estimated percent of successful propagation, the amount of propagation space needed, and date propagation will be started and completed. Propagation date, number of propagules needed, propagation percentages, and propagating space must be calculated.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Propagation manual
Plant production schedule

ENABLING OBJECTIVES:

1. Look up plant propagation method.
2. Use calculator to add, subtract, multiply and/or divide.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Plant production schedule.
6. Checklist - Planning plant propagation schedules.

TEACHING ACTIVITIES:

1. Discuss the importance of planning to successful plant propagation.
2. List horticultural crops. (* 1,2 & 3)
3. Question students on the propagation method best suited for the listed horticultural crops.
4. List resources available for helping to determine the propagation method for the horticultural crop. (* 1,2,3 & 4)
5. List factors to consider when determining the propagation method for the horticultural crop. (* 1,2,3 & 4)
6. Present lecture on estimating the time required to propagate the horticultural crop. (* 1,2,3 & 4)
7. Present lecture on estimating the propagation success rate. (* 1,2,3 & 4)
8. Present lecture on determining the number of propagules needed. (* 1,2,3 & 4)
9. List factors to consider when determining the spacing during propagation for a horticultural crop. (* 1,2,3 & 4)
10. Show an example of a plant propagation schedule. (* 5)
11. Assign each student a plant production schedule for which to plan the plant propagation schedule. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the plants to be propagated, calculate the date to start propagation process, the number of propagules needed and the space needed to propagate the plants. The student must explain and/or site references regarding the reasons for the date to start, the number of propagules needed and the space needed.

PERFORMANCE GUIDE:

1. Obtain plant production schedule.
2. Identify the needed cultivars, the number of plantlets needed, and the date which they are needed form the plant production schedule.
3. Estimate length of time needed to propagate specific cultivar by specified propagation method.
4. Calculate propagation date by the following formula:
   Plantlet harvest date - required length of propagation = date to start propagation process.

PERFORMANCE GUIDE: (cont.)

5. Estimate the number of propagules needed for propagation process:
    - A. Estimate the percentage of propagules that will be successfully propagated.
    - B. Calculate number of needed propagules by the following formula:
        Number of needed plantlets divided by the estimated propagation percentage = number of needed propagules.
6. Calculate amount of propagation space needed by the following formula:
    Number of propagules divided by desired spacing (number cuttings per square foot) = total square feet of propagating space.

CHECKLIST

DUTY Performing Administrative Functions

TASK Plan plant propagation schedules.

ENABLER

1. Look up plant propagation method.
2. Use calculator to add, subtract, multiply and/or divide.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plan plant propagation schedules.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed the needed cultivars.		
2. Listed the number of plantlets needed.		
3. Listed the date which the plantlets are needed.		
4. Listed length of time needed to propagate specific cultivar.		
5. Calculated the propagation date.		
6. Listed the percentage of propagules that will be successfully propagated (estimate).		
7. Listed the number of propagules needed for propagation process.		
8. Listed the amount of propagation space needed.		

DUTY: PERFORMING ADMINISTRATIVE FUNCTIONS

PERFORMANCE OBJECTIVE NO. 25

TASK: Determine method of propagation.

STANDARD OF PERFORMANCE OF TASK:

Recommended method of propagation must be based on plantlet quality and maximize projected profit.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Plant propagation manual
Plant production schedule

ENABLING OBJECTIVES:

1. Look up recommended propagation method(s).
2. Ask others about propagation methods.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Plant production schedule.
6. Plant propagation schedule.
7. Checklist - Determining method of propagation.

TEACHING ACTIVITIES:

1. Discuss the importance of selecting the best propagation method.
2. List factors to consider when selecting a propagation method. (* 1,2 & 3)
3. List horticulture crops. (* 5 & 6)
4. Question students on propagation methods for the listed horticulture crops.
5. Assign students to look up and list the propagation method for the listed plants. (* 1,2,3 & 4)
6. Present a lecture on an example of a hypothetical or real plant propagation operation.
7. Question students on the propagation method(s) that would be best for the hypothetical or real propagation operation.
8. Discuss the students' suggestions for the propagation method(s).
9. Present lecture on recording propagation method on the propagation schedule. (* 6)
10. Assign each student a list of horticulture crops and a propagation facility for which to determine the method of propagation. (* 7)

CRITERION-REFERENCED MEASURE:

The student must list and rank the possible propagation methods and record the advantages and disadvantages of each of the propagation methods. The list of propagation methods must be complete and the student must explain the ranking of the propagation methods.

PERFORMANCE GUIDE:

1. Obtain plant production schedule.
2. Identify cultivars that will be propagated using plant production schedule.
3. Identify recommended methods of propagation for particular cultivar:
   A. Sexual:
      1. Seed.
      2. In vitro culture system.
   B. Asexual:
      1. Grafting.
      2. Budding.
      3. Cuttings.
      4. Division.
      5. Layering.
      6. In vitro culture system.

PERFORMANCE GUIDE: (cont.)

4. Compare recommended methods of propagation for particular cultivar:
    - A. Estimate cost of propagation:
        1. Length of propagation process.
        2. Amount of space required.
        3. Additional equipment needed.
        4. Temperature requirements.
        5. Labor requirements.
    - B. Estimate quality of finished plantlet.
5. Rank recommended methods of propagation for particular cultivar.
6. Identify the best suited propagation method for particular cultivar for current operation.

CHECKLIST

DUTY Performing Administrative Functions

TASK Determine method of propagation.

ENABLER

1. Look up recommended propagation method(s).
2. Ask others about propagation methods.

STUDENT'S NAME ______________________ **DATE** __________

EVALUATOR'S NAME ______________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to determine method of propagation.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Listed cultivars that will be propagated.		
2.	Listed recommended methods of propagation for each cultivar.		
3.	Estimated cost of propagation:		
	- Length of propagation process.		
	- Amount of space required.		
	- Additional equipment needed.		
	- Temperature requirements.		
	- Labor requirements.		
4.	Listed expected quality of finished plantlet.		
5.	Ranked recommended methods of propagation for particular cultivar.		
6.	Identified the best suited propagation method for each cultivar.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 26

TASK: Collect soil samples.

STANDARD OF PERFORMANCE OF TASK:

The core sample must be representative of one uniform growing area. The composite soil sample must be uniformly mixed, dried, and screened to yield one pint of soil.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Field
Bench/bed
Soil probe
Soil auger
Plastic bucket

ENABLING OBJECTIVES:

1. Read soil survey map.
2. Identify soil treatments performed on fields, beds or potted crops from crop records.
3. Write or print information on laboratory information sheet.

***RESOURCES:**

1. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.
2. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley and Sons, Inc.
3. Buchholz, D. (1985). How to get a good soil sample. Columbia, MO: Cooperative Extension Service, University of Cornell.
4. Donahue, R., Follett, R., & Tulloch, R. (1983). Our soils and their management. Danville, IL: The Interstate Printers and Publishers, Inc.
5. Sopher & Baird. (1981). Soils and soil management. Fort Worth, TX: Branch-Smith Publishing.
6. Davies, D., Eagle, D., & Finney J. (1982). Soil management. Fort Atkinson, WI: Nasco.

*RESOURCES: (cont.)

7. Cooperative Extension, Cornell University. (1981). Cornell recommendations for commercial floriculture crops part 1: Cultural practices and production programs. Ithaca, NY: Author.
8. Laboratory information sheet.
9. Checklist - Collecting soil samples.

TEACHING ACTIVITIES:

1. Outline procedures used to collect soil samples. (* 3)
2. Show examples of core samples that were all taken from one field, yet are visibly different.
3. Present lecture on reasons why many core samples are taken and then mixed. (* 1,2,4,5,6 & 7)
4. Present lecture on reasons why core samples are taken on 6"-8" deep.
5. Present lecture on reasons mulch or other debris must not be included in the soil sample.
6. Show an example of a soil survey map.
7. Question students on differences in soil type within a field shown on the soil survey map.
8. Show examples of crop records.
9. Question students on differences in soil treatments within a field.
10. Question students on the usefulness of information gained from a soil test performed on a soil sample that was a mixture of soil types and fertility practices.
11. Demonstrate how to take a core sample in a field, bench, bed and/or block of potted plants.
12. Assign students to determine where the next core samples should be taken within the field, bench bed and/or block of potted plants.
13. Discuss the importance of excluding mulch or other debris.
14. Monitor students as they practice taking core samples.
15. Demonstrate how to mix the core samples.
16. Demonstrate how to place the composite sample for drying.
17. Demonstrate how to screen a dry composite sample
18. Demonstrate how to complete the laboratory information sheet. (* 8)
19. Assign each student a field, bench, bed and/or block of potted plants from which to collect soil samples. (* 9)

CRITERION-REFERENCED MEASURE:

The student must identify areas of a field having different soil types or fertility practices or identity areas of a bench/bed or block of potted plants which have received different fertility treatments, take representative core samples, mix the core samples, dry and screen the composite sample and complete the laboratory information sheet. Any differences in soil type or fertility treatments must be described, at least 10 core samples must be taken from benches, beds or blocks of potted plants and at least 20 from fields, the core samples must be taken equal distance apart (plus or minus 10%) and no portion of the field, bench, bed or block of plants that is larger than 20% of the surface area must go unsampled. The core samples must be mixed, dried and screened according to specifications with no visible signs of debris and the laboratory information sheet must contain all requested information and be legible.

PERFORMANCE GUIDE:

1. Identify growing area (field, bench, container) from where sample will be taken:
    A. Field sample:
        1. Identify field on a soil survey map.
        2. Note any soil differences within the field:
            a. Examine field for differences in soil type, soil color, soil texture, slope, crop rotation and fertility practices.
            b. Avoid combining any of the known soil differences when taking a particular composite sample.
               NOTE: A composite sample should not represent more than 20 acres.
        3. Insert a soil probe or soil auger to a depth of 6"-7" or to tillage depth if deeper.
           NOTE: Remove any mulch from the site of core sample.
        4. Remove core sample from probe/auger into a plastic bucket.
        5. Take 14-19 additional core samples at random while walking in a zigzag pattern across the field.
        6. Mix the 15-20 core samples together to form a composite sample.

PERFORMANCE GUIDE: (cont.)

- B. Bench crops/ground beds:
    - 1. Insert soil probe/auger to a depth of 6"-7" into media in bench/bed.
      NOTE: Scrape mulch away from site of core sample.
    - 2. Take at least 9 additional core samples from 9 different locations on bench/bed.
    - 3. Mix the 10 core samples together to form a composite sample in a plastic bucket.
- C. Potted crops:
    - 1. Insert soil probe/auger to a depth of 6"-7" in media in a pot representative of the crop.
      NOTE: Only crops with the same media and fertility practices should be included in the same composite soil sample.
    - 2. Take at least 9 additional core samples from 9 randomly selected pots.
    - 3. Mix the 10 core samples together to form a composite sample.

2. Dry composite sample on a clean non-absorbent surface.
3. Screen any debris from samples.
4. Retain at least one pint of composite soil sample for analysis.
5. Complete needed laboratory information on information sheet.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Collect soil samples.

ENABLER

1. Read soil survey map.
2. Identify soil treatments performed on fields, beds or potted crops from crop records.
3. Write or print information on laboratory information sheet.

STUDENT'S NAME______________________________ DATE__________

EVALUATOR'S NAME____________________________ COURSE________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to collect soil samples.

PERFORMANCE DETERMINANTS	YES	NO
Field sample:		
1. Identified field on a soil survey map.	______	______
2. Noted any soil differences within the field.	______	______
3. Avoided combining any of the known soil differences when taking a particular composite sample.	______	______
4. Inserted a soil probe or soil auger to a depth of 6"-7" or to tillage depth if deeper.	______	______
5. Removed any mulch from the site of core sample.	______	______
6. Removed core sample from probe/auger.	______	______
7. Took 14-19 additional core samples at random while walking in a zigzag pattern across the field.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
8. Mixed the 15-20 core samples together to form a composite sample.	________	________
Bench crops/ground beds:		
9. Inserted soil probe/auger to a depth of 6"-7" into media in bench/bed.	________	________
10. Took at least 9 additional core samples from 9 different locations on bench/bed.	________	________
11. Mixed the 10 core samples together to form a composite sample.	________	________
Potted crops:		
12. Inserted soil probe/auger to a depth of 6"-7" in media in a pot representative of the crop.	________	________
13. Took at least 9 additional core samples from 9 randomly selected pots.	________	________
14. Mixed the 10 core samples together to form a composite sample.	________	________
15. Dried composite sample on a clean non-absorbent surface.	________	________
16. Screened any debris from samples.	________	________
17. Retained at least one pint of composite soil sample for analysis.	________	________
18. Completed needed laboratory information on information sheet.	________	________

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 27

TASK: Test soil sample.

STANDARD OF PERFORMANCE OF TASK:

The soil tests for specific composite sample must be determined and performed. All manufacturer's directions on use of soil testing equipment must be followed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Scales
Meter, pH
Reagent, pH
Thermometer
Filter paper
Hydrion papers
Distilled water
Soil sample box
Soil information sheet
Composite soil sample
Solubridge soil tester
Soil fertility test kit
250 ml graduated cylinder
100 ml graduated cylinder

ENABLING OBJECTIVES:

1. Read soil testing equipment instructions.
2. Read soil test kit instructions.
3. Recall requirements of a soil sample.
4. Recall plant nutrient names.
5. Recall scale used to measure pH.

*RESOURCES:

1. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley and Sons, Inc.
2. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.

*RESOURCES: (cont.)

3. Donahue, R., Follett, R., & Tulloch, R. (1983). Our soils and their management. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
5. Kohnke, H. (1980). Soil science simplified. Fort Atkinson, WI: Nasco.
6. Soil test kit instructions.
7. Soil testing equipment instructions.
8. Checklist - Testing soil samples.

TEACHING ACTIVITIES:

1. Question students on the possible results of an incorrectly performed soil test.
2. List the types of information gained from soil tests. (* 1,2,3,4 & 5)
3. Show examples of soil samples.
4. Demonstrate how to perform a fertility test. (* 6 & 7)
5. Demonstrate how to determine the pH of the soil sample. (* 6 & 7)
6. Demonstrate how to test for soluble salts. (* 6 & 7)
7. Question students on care of the laboratory equipment.
8. Assign each student a soil sample to test. (* 8)

CRITERION-REFERENCED MEASURE:

The student must perform all soil tests assigned, record the test results and clean and store the laboratory equipment. The recorded test results must be legible and correspond to the test results obtained from the same soil sample when tested by the test administrator. All manufacturers directions must be followed and all equipment must be cleaned and stored according to manufacturer's directions.

PERFORMANCE GUIDE:

1. Identify soil tests to perform on specific composite soil samples.

PERFORMANCE GUIDE: (cont.)

2. Perform soil tests:
    A. Fertility test:
        1. Obtain a soil fertility test kit.
        2. Identify the nutrient tests to be performed.
        3. Follow manufacturer's directions in performing all tests.
    B. Test to determine pH:
        1. Perform pH test using a pH meter according to manufacturer's recommendations.
        2. Perform pH test using hydrion papers according to manufacturer's recommendations.
        3. Perform pH test using a reagent according to manufacturer's recommendations.
    C. Test for soluble salts:
        1. Obtain solubridge soil tester.
        2. Prepare soil sample for salinity test:
            a. Weigh out 20 grams of air-dry soil.
            b. Place soil in a 250 ml beaker.
            c. Add 100 ml of distilled water to the soil.
            d. Stir thoroughly.

               NOTE: After sample and water have been stirred, allow sample to stand for 30 minutes. Stir occasionally during this period.
            e. Filter sample into a 100 ml graduated cylinder.
            f. Discard filter paper and soil.
            g. Record the temperature of the extract in the graduated cylinder.
        3. Follow manufacturer's directions in performing salinity tests.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Test soil sample.

ENABLER

1. Read soil testing equipment instructions.
2. Read soil test kit instructions.
3. Recall requirements of a soil sample.
4. Recall plant nutrient names.
5. Recall scale used to measure pH.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to test soil sample.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed soil tests to perform on specific composite soil samples.	________	________
Fertility test:		
2. Listed the nutrient tests to be performed.	________	________
3. Followed manufacturer's directions in performing all tests.	________	________
Tested to determine pH:		
4. Performed pH test using a pH meter according to manufacturer's recommendations.	________	________
5. Performed pH test using hydrion papers according to manufacturer's recommendations.	________	________
6. Performed pH test using a reagent according to manufacturer's recommendations.	________	________

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Tested for soluble salts:		
7. Identified solubridge soil tester.	________	________
8. Weighed out 20 grams of air-dry soil.	________	________
9. Placed soil in a 250 ml beaker.	________	________
10. Added 100 ml of distilled water to the soil.	________	________
11. Stirred the soil and water.	________	________
12. Filtered sample into a 100 ml graduated cylinder.	________	________
13. Discarded filter paper and soil.	________	________
14. Recorded the temperature of the extract in the graduated cylinder.	________	________
15. Followed manufacturer's directions in performing salinity tests.	________	________

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 28

TASK: Pasteurize growing media.

STANDARD OF PERFORMANCE OF TASK:

The moistened medium must be uniformly heated to optimum pasteurization temperature, 71° C (160° F). The optimum pasteurization temperature must be maintained for 30 minutes before allowing medium to cool.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Medium
Shovel
Soil wagon
Steamproof tarp
Soil thermometer
Steam pipes/hoses
Boiler/steam generator
Electric soil sterilizer

ENABLING OBJECTIVES:

1. Recognize uniformly mix media.
2. Evaluate soil moisture content.
3. Mix disinfestant solution.
4. Measure temperature.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.

***RESOURCES:** (cont.)

6. Boiler/steam generator operating instructions.
7. Electric soil sterilizer operating instructions.
8. Checklist - Pasteurizing growing media.

TEACHING ACTIVITIES:

1. Question students on the possible results of incomplete pasteurization of the growing media.
2. Outline overall procedures used to pasteurize growing media using steam or electricity. (* 1,2,3,4 & 5)
3. Discuss the importance of avoiding clumps in the media or nonuniform media.
4. Discuss the importance of moistening the media uniformly prior to heating the media.
5. List the advantages and disadvantages of pasteurization using steam and pasteurization using electricity. (* 1,2,3,4 & 5)
6. Present lecture on the affects of heating the media to 140°, 160°, 180° or hotter. (* 1,2,3,4 & 5)
7. Question students on the safety precautions they would take when working with steam and/or electric soil sterilizers.
8. Assign students to prepare media for pasteurization.
9. Demonstrate how to set up steam and/or electric soil pasteurization equipment. (* 6 & 7)
10. Demonstrate how to place the soil thermometer.
11. Demonstrate how to start boiler/steam generator and/or set electric soil sterilizer. (* 6 & 7)
12. Assign students to check the soil thermometer at regular intervals.
13. Demonstrate how to turn off boiler/steam generator and/or electric soil sterilizer. (* 6 & 7)
14. Discuss the importance of allowing the media and the equipment to cool before handling.
15. Discuss the importance of avoiding contamination of pasteurized media.
16. Question students on soil pasteurization safety.
17. Assign each student an amount of media to pasteurize. (* 8)

CRITERION-REFERENCED MEASURE:

The student must mix the medium, moisten the medium, set up and start the soil pasteurization equipment, check the soil thermometer, time the length of the heating and turn off the soil sterilization equipment. The medium must be uniformly mixed (no clumps larger than 1 inch and any two samples are visually the same), and moistened (medium forms clump when squeezed, but does not drip water), the soil pasteurization equipment must be operated according to the manufacturer's instructions, the medium must be heated to 71° C (160° F) for 30 minutes and the medium must be allowed to cool before handling.

PERFORMANCE GUIDE:

1. Shred/mix the medium to produce a uniform medium.
2. Moisten medium uniformly.
3. Identify method of pasteurization:
   A. Pasteurize medium with steam:
      1. Determine how the medium will be used:
         a. Load medium into soil wagon or soil sterilizer if medium will be used for potting.
         b. Lay steam pipe through medium in bench or ground bed.
      2. Cover wagon, ground bed, or bench with a steam proof tarp.
      3. Insert soil thermometer into medium to a depth of 8-12 inches with the temperature indicator exposed for viewing.
      4. Hook up steam pipes/hoses to medium from boiler/steam generator.
   B. Pasteurize medium by electricity:
      1. Disinfect area where soil will be pasteurized.
      2. Place electric soil sterilizer on floor.
      3. Fill electric soil sterilizer with medium.
      4. Insert soil thermometer into medium to a depth of 8-12 inches.
      5. Place lid on top of soil sterilizer.
      6. Plug electrical sterilizer into electrical outlet.
      7. Set temperature indicator for optimum pasteurization temperature.

PERFORMANCE GUIDE: (cont.)

4. Heat until temperature throughout the medium reaches the optimum point:
   CAUTION: Serious burns may result if heated equipment is mishandled.
   NOTE: If medium is heated until the temperature reaches 82° C (180° F), beneficial microorganisms in the medium will also be killed and ammonium, nitrite, and manganese toxicities may occur.
   A. Heat until medium temperature reaches 71° C (160° F).
      NOTE: All harmful microorganisms may not be killed.
   B. Heat using aerated steam until medium temperature reaches 60° C (140° F).
      NOTE: A specialized air:steam mixer is needed to force steam through the medium.
5. Maintain optimum temperature for 30 minutes.
6. Turn off the boiler/steam generator, or soil sterilizer.
7. Allow medium, steam pipes, and other equipment to cool before handling.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Pasteurize growing media.

ENABLER

1. Recognize uniformly mix media.
2. Evaluate soil moisture content.
3. Mix disinfestant solution.
4. Measure temperature.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to pasteurize growing media.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Shredded/mixed the medium.	______	______
2.	Moistened medium.	______	______
Pasteurize medium with steam:			
3.	Loaded medium into soil wagon or soil sterilizer if medium will be used for potting.	______	______
4.	Laid steam pipe through medium in bench or ground bed.	______	______
5.	Covered wagon, ground bed, or bench with a steam proof tarpaulin.	______	______
6.	Inserted soil thermometer into medium to a depth of 8-12 inches with the temperature indicator exposed for viewing.	______	______
7.	Hooked up steam pipes/hoses to medium from boiler/steam generator.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Pasteurize medium by electricity:		
8. Disinfected area where soil will be pasteurized.		
9. Placed electric soil sterilizer on floor.		
10. Filled electric soil sterilizer with medium.		
11. Inserted soil thermometer into medium to a depth of 8-12 inches.		
12. Placed lid on top of soil sterilizer.		
13. Plugged electrical sterilizer into electrical outlet.		
14. Set temperature indicator.		
15. Heated until temperature throughout the medium reaches the optimum point.		
16. Maintained optimum temperature for 30 minutes.		
17. Turned off the boiler/steam generator, or soil sterilizer.		
18. Allowed medium, steam pipes, and other equipment to cool before handling.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 29

TASK: Sterilize media with chemical soil sterilant.

STANDARD OF PERFORMANCE OF TASK:

The chemical soil sterilant must be applied according to manufacturer's recommendations. The length of treatment and length of aeration must be as specified by manufacturer. Protective clothing must be worn, a warning sign must be placed in treatment area, and all recommended safety precautions must be strictly observed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Warning sign
Watering can
Cultivation tool
Airtight material
Protective clothing
Chemical soil sterilant

ENABLING OBJECTIVES:

1. Recognize uniformly mixed media.
2. Recall cultivation equipment safety.
3. Read pesticide label.
4. Recall protective clothing to wear when applying toxic chemicals.
5. Recall regulations regarding restricted-use pesticides.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.

***RESOURCES:** (cont.)

5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
6. Chemical sterilant label.
7. Checklist - Sterilizing media with chemical soil sterilant.

TEACHING ACTIVITIES:

1. Question students on the possible result of incomplete sterilization of the growing media.
2. Present lecture on the level of toxicity of chemical soil sterilants. (* 1,2,3,4,5 & 6)
3. Question students on the protective clothing to wear when using a chemical soil sterilant. (* 1,2,3,4,5 & 6)
4. Question students on safety precautions to take to protect others when using a chemical soil sterilant. (* 1,2,3,4,5 & 6)
5. Question students on regulations regarding restricted-use pesticides.
6. Assign students to cultivate the media.
7. Demonstrate how to cover the media with air tight material.
8. Demonstrate (using water only) how a liquid chemical soil sterilant is applied.
9. Demonstrate how to place a warning sign.
10. Evaluate each students ability to don protective clothing.
11. Question each student on safety precautions they would take to protect others when using chemical soil sterilants.
12. Assign each student an amount of media to sterilize using a chemical soil sterilized. (* 7)

CRITERION-REFERENCED MEASURE:

The student must cultivate the media, read and the pesticide label, explain the procedures to be followed (including the safety precautions) to the test administrator, and apply the chemical soil steriliant. The media must be uniformly cultivated (no clumps larger than 2 inches and any to samples are visually the same). The chemical soil sterilant must be applied according to manufacturer's recommendations. The length of treatment and length of aeration must be as specified by manufacturer. Protective clothing must be worn, a warning sign must be placed in treatment area, and all recommended safety precautions must be strictly observed.

PERFORMANCE GUIDE:

1. Identify area to be sterilized.
2. Cultivate media uniformly.
3. Select chemical to sterilize media.
4. Read label on chemical sterilant.
   CAUTION: Manufacturer's recommendations and directions must be understood before application is started. Follow all manufacturer's recommendations and safety precautions. The label will specify whether the pesticide is for general or restricted use. A restricted-use pesticide can be used by only certified applicators or by people who are directly supervised by the certified applicator.
5. Wear protective clothing.
6. Place sign in area warning that chemical sterilization is in progress.
7. Apply chemical according to manufacturer's recommendations:
   CAUTION: Many of the chemical soil sterilants are extremely toxic, so manufacturer's recommendations must be strictly followed. Many of the chemical sterilants cannot be used in enclosed areas, such as a greenhouse, and must only be used outdoors.
   A. Soil fumigant:
      1. Cover media with airtight material.
      2. Inject fumigant into media under airtight seal.
         CAUTION: Avoid chemical contact with skin and avoid breathing any fumes from the chemicals. Wash after using the chemical.
      3. Leave covered for specified time according to manufacturer's recommendations.
         NOTE: Media is generally covered from 2-4 days.
      4. Remove airtight cover.
         B. Liquid chemical soil sterilant:
            1. Apply liquid soil sterilant with watering can or irrigation system.
               CAUTION: Avoid chemical contact with skin and avoid breathing any fumes from the chemical. Wash after using chemical.

PERFORMANCE GUIDE: (cont.)

2. Seal media as specified by manufacturer's recommendations.
   NOTE: Media is generally sealed by covering with airtight material for several days, rolling the media with a lawn roller or by forming a water seal.

8. Allow media to air out for specified time before using, following manufacturer's recommendations.
   NOTE: Generally aeration time is 1-3 weeks.
9. Remove warning sign from area.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Sterilize media with chemical soil sterilant.

ENABLER

1. Recognize uniformly mixed media.
2. Recall cultivation equipment safety.
3. Read pesticide label.
4. Recall protective clothing to wear when applying toxic chemicals.
5. Recall regulations regarding restricted-use pesticides.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to sterilize media with chemical soil sterilant.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified area to be sterilized.		
2.	Cultivated media.		
3.	Selected chemical to sterilize media.		
4.	Read label on chemical sterilant.		
5.	Wore protective clothing.		
6.	Placed sign in area warning that chemical sterilization is in progress.		
Soil fumigant:			
7.	Covered media with airtight material.		
8.	Injected fumigant into media under airtight seal.		
9.	Left media covered for specified time according to manufacturer's recommendations.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Removed airtight cover.	________	________
Liquid chemical soil sterilant:		
11. Applied liquid soil sterilant with watering can or irrigation system.	________	________
12. Sealed media as specified by manufacturer's recommendations.	________	________
13. Allowed media to air out for specified time before using, following manufacturer's recommendations.	________	________
14. Removed warning sign from area.	________	________

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 30

TASK: Mix growing media.

STANDARD OF PERFORMANCE OF TASK:

Ingredients of a growing medium recipe must be measured as specified and mixed to form a uniform growing medium.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Scales
Shovel
Soil mixer
Front-endloader
Recipe for growing medium
Ingredients of growing medium

ENABLING OBJECTIVES:

1. Recall growing medium ingredients.
2. Read growing medium recipe.
3. Recall soil mixer safety considerations.
4. Identify growing medium ingredients.
5. Lift, carry and dump growing media ingredients.
6. Recall units of measurement.

***RESOURCES:**

1. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley & Sons, Inc.
2. Kohnke, H. (1980). Soil science simplified. Fort Atkinson, WI: Nasco.
3. Beck, R., Banwart, W., & Hassett, J. (1984). Introductory soil science: A laboratory. Champaign, IL: Stipes Publishing Co.
4. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
5. Tisdale. (1985). Soil fertility & fertilizers (4th ed.). New York, NY: Macmillan.
6. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.

***RESOURCES:** (cont.)

7. Plaster, E. (1985). Soil science and management. Albany, NY: Delmar Publishers Inc.
8. Checklist - Mixing growing medium.

TEACHING ACTIVITIES:

1. Show examples of growing medium.
2. Outline overall procedure used to mix growing medium.
3. Discuss the importance of accurate measurement and thorough blending of growing medium ingredients.
4. Present lecture on growing medium recipes in which the ingredients must be combined in a particular order. (* 1,2,3,4,5,6 & 7)
5. Question students on identification of growing medium ingredients. (* 1,2,3,4,5,6 & 7)
6. Question students on safety considerations regarding growing medium ingredients.
7. Demonstrate how to measure specified amounts of a variety of types of growing medium ingredients.
8. Monitor students as they practice measuring specified amounts of growing medium ingredients.
9. Show tools, equipment and/or work area required to mix growing medium.
10. Demonstrate how to combine growing medium ingredients.
11. Demonstrate how to blend growing medium ingredients by hand.
12. Question students on soil mixer safety.
13. Demonstrate how to blend soil using a soil mixer.
14. Demonstrate how to evaluate the uniformity of the growing medium.
15. Monitor the students as they practice measuring, combining and blending the growing medium ingredients.
16. Assign each student a growing medium recipe to mix. (* 8)

CRITERION-REFERENCED MEASURE:

The student must measure each ingredient, combine and blend the ingredients. The amount of the ingredient added must be the same amount specified in the recipe (plus or minus 2%). The ingredients must be blended (any two samples contain the same proportion of ingredients) and any clumps must be broken up or removed (any sample has not more than one clump larger than 1/2 inch).

PERFORMANCE GUIDE:

1. Obtain the ingredients used in the growing medium recipe.
2. Measure the specified amount of each ingredient, according to the growing medium's recipe:
   - A. Soil.
   - B. Amendments.
   - C. Wetting agent.
   - D. Major elements.
   - E. Trace elements.
   - F. Lime or sulfur.
   - G. Pesticides, if recommended.
3. Combine the ingredients.
4. Blend ingredients thoroughly until a uniform growing medium is obtained.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Mix growing media.

ENABLER

1. Recall safety considerations regarding growing medium ingredients.
2. Read growing medium recipe.
3. Recall soil mixer safety considerations.
4. Identify growing medium ingredients.
5. Evaluate the uniformity of the growing medium.

STUDENT'S NAME____________________________ **DATE**__________

EVALUATOR'S NAME__________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to mix growing medium.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified growing medium ingredients.		
2. Handled growing medium ingredients safely.		
3. Measured each ingredient.		
4. Combined ingredients.		
5. Combined ingredients in specified order.		
6. Blended ingredients.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 31

TASK: Alter pH of growing media.

STANDARD OF PERFORMANCE OF TASK:

The pH of growing medium must be modified to the optimum level for specified crop species or receive the maximum recommended application rate of modifying material for specific soil type during a specified season.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Site
Lime
Sulfur
Spreader
Soil manual
Fertilizer
Iron sulfate
Growing medium
Organic matter
Aluminum sulfate
Crop production manual
Incorporating equipment/tools
Growing medium pH test results

ENABLING OBJECTIVES:

1. Read pH test results.
2. Look up pH requirements of crop.
3. Read application equipment instructions.
4. Recall CEC characteristics of organic matter and/or clay.
5. Recall units of measurement (weight/volume).

***RESOURCES:**

1. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley and Sons, Inc.
2. Beck, R., Banwart, W., & Hassett, J. (1984). Introductory soil science laboratory. Champaign, IL: Stipes Publishing Co.

***RESOURCES:** (cont.)

3. Donahue, R., Follett, R., & Tulloch, R. (1983). Our soils and their management. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Davies, D., Eagle, D., & Finney J. (1982). Soil management. Fort Atkinson, WI: Nasco.3
5. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.
6. pH test results.
7. Application equipment instructions.
8. Checklist - Altering the pH of growing media.

TEACHING ACTIVITIES:

1. List crops that have specific pH requirements.
2. Present lectures on the availability of various elements according to pH level.
3. List soils or media that have high or low pH levels. (* 1,2,3,4,5 & 6)
4. List materials used to alter the pH of a soil or medium. (* 1,2,3,4 & 5)
5. Present lecture on the advantages and/or disadvantages of materials used to alter the pH of a soil or medium. (* 1,2,3,4 & 5)
6. Present lecture on adjustment in the amount of pH altering material needed due to the organic matter content of the soil. (* 1,2,3,4 & 5)
7. Demonstrate how to determine the amount of organic matter of a soil (visually, using soil test results or using laboratory equipment).
8. Question students on their opinion of the organic matter content of various soil samples.
9. Demonstrate how to apply a pH altering material. (* 7)
10. Discuss the importance of uniform application of pH altering materials.
11. Assign each student area for which to alter the pH. (* 8)

CRITERION-REFERENCED MEASURE:

The student must list the current pH of the soil, the organic matter content of the soil, the optimum pH for the crop, the pH altering material to be used and the rate at which the pH altering material is to be applied. The student must apply and incorporate the pH altering material. The listed information must be complete and correspond to the

CRITERION-REFERENCED MEASURE: (cont.)

recommendations for altering the pH determined by the test administrator. The pH altering material must be applied uniformly at the listed rate and incorporated into the growing medium.

PERFORMANCE GUIDE:

1. Obtain growing medium pH test results for specified growing medium.
2. Identify current pH level of the growing medium.
3. Calculate the amount of organic material present in the growing medium and the texture of the growing medium.
4. Identify recommended pH level for specified plant species from a plant production manual.
5. Identify degree of modification required to obtain optimum plant growth.
6. Modify soil pH:
    A. Raise pH:
        1. Apply fertilizer that has an alkaline effect on pH during fertilization process.
        2. Apply lime to soil:
           CAUTION: Do not exceed an application rate of 4 tons/acre during any one season.
            a. Select type of liming material to apply.
               CAUTION: Calcium hydroxide (Hydrated lime) should not be applied while plants are growing in the soil due to its quick reaction capabilities.
            b. Identify rate of application for specific liming material from crop production or soil manuals.
            c. Incorporate lime into soil.
    B. Lower pH:
        1. Apply fertilizer that has an acidic effect on pH during fertilization process.
        2. Incorporate organic matter that has a lower pH into the soil.

PERFORMANCE GUIDE: (cont.)

3. Apply iron sulfate, aluminum sulfate, or sulfur:

   CAUTION: Overapplications of aluminum sulfate can result in aluminum toxicity.

   a. Select type of material to apply.
   b. Calculate rate of application for specified material from crop production or soil manual.
   c. Incorporate specified material into the soil.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Alter pH of growing media.

ENABLER

1. Read pH test results.
2. Look up pH requirements of crop.
3. Read application equipment instructions.
4. Recall CEC characteristics of organic matter.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to alter pH of growing media.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Recorded pH test results.		
2.	Listed pH level.		
3.	Recorded the amount of organic material present.		
4.	Listed recommended pH level for specified plant species.		
5.	Listed degree of modification required to obtain optimum plant growth.		
6.	Applied fertilizer that has an alkaline effect on pH during fertilization process.		
7.	Applied lime to soil.		
8.	Applied fertilizer that has an acidic effect on pH during fertilization process.		
9.	Incorporated organic matter that has a lower pH into the soil.		
10.	Applied iron sulfate, aluminum sulfate, or sulfur.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 32

TASK: Prepare compost pile.

STANDARD OF PERFORMANCE OF TASK:

Plant material and soil must be layered. A slight depression must be left across the top of the compost pile. Moisten compost pile as needed. Compost pile must be turned at least one time after 1-2 week period.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Lime
Shovel
Mattock
Pitchfork
Fertilizer
Animal manure
Organic matter

ENABLING OBJECTIVES:

1. Recall value of compost material.
2. Evaluate moisture content of compost pile.
3. Measure fertilizer (weight/volume).

***RESOURCES:**

1. Shewell, & Cooper. (1975). Compost gardening. New York, NY: Macmillan.
2. Minnich, J., Hunt, M. (1979). Rodale guide to composting. Emmaus, PA: Rodale Press.
3. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.
4. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.
5. Checklist - Preparing a compost pile.

TEACHING ACTIVITIES:

1. Show examples of composted materials.
2. Question students on the uses of composted materials.
3. List sources of organic matter. (* 1,2,3 & 4)
4. Show examples of organic matter.
5. Present lecture on composting as a disposal method. (* 1 & 2)
6. Present lecture on environmental factors needed for decay of organic matter. (* 1,2,3 & 4)
7. Present lecture on carbon to nitrogen ratio and its effect on decomposition.
8. Present lecture on materials used to make the layers of the compost pile. (* 1 & 2)
9. List carbon and nitrogen content of the materials used in a compost pile.
10. Present lecture on adjusting the pH of the compost pile. (* 1,2,3 & 4)
11. Present lecture on turning and watering the compost pile. (* 1 & 2)
12. Assign students organic matter to compost. (* 5)

CRITERION-REFERENCED MEASURE:

The student must build the compost pile, keep the compost pile moist and turn the compost pile. The compost pile must include all specified layers, have a slight depression across the top, remain moist and show signs of aeration (organic matter decomposes).

PERFORMANCE GUIDE:

1. Select a suitable location for the compost pile.
2. Identify size of compost pile.
   Note: The compost pile should be at least 3 feet high.
3. Pile 8 inch layer of plant material on the ground.
   NOTE: Plant material may include leaves, lawn clippings, and weeds.
4. Spread two inches of soil over the first layer.
5. Spread two inches of animal manure, if desired, over the soil.
6. Sprinkle bone meal and/or commercial fertilizer over plant material and manure, if desired.
7. Sprinkle lime on top of layers, if desired.
   NOTE: Do not apply lime to the compost pile if a compost with a low pH is desired.
8. Continue layering plant material, soil, manure, fertilizer, and lime.

PERFORMANCE GUIDE: (cont.)

9. Shape the compost pile so a slight depression remains across the top of the compost pile to catch natural moisture.
10. Water compost as needed to keep plant material moist.
11. Turn the top layers of the compost pile onto the ground next to the pile after 1-2 weeks and rebuild it in the same shape.
12. Turn pile several more times during composting process.

CHECKLIST

DUTY Preparing Soil And Growing Media

TASK Prepare compost pile.

ENABLER

1. Recall value of composted material.
2. Evaluate moisture content of compost pile.
3. Measure fertilizer (weight/volume).

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare a compost pile.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected a suitable location for the compost pile.		
2.	Identified the desired size of compost pile.		
3.	Piled an 8 inch layer of plant material on the ground.		
4.	Spread two inches of soil over the first layer.		
5.	Spread two inches of animal manure over the soil.		
6.	Sprinkled bone meal and/or commercial fertilizer over the plant material.		
7.	Sprinkled lime on top of layers.		
8.	Shaped the compost pile so a slight depression remained across the top of the compost pile.		
9.	Watered compost as needed.		
10.	Turned the compost pile.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 33

TASK: Calculate fertilizer requirements.

STANDARD OF PERFORMANCE OF TASK:

Fertilizer requirements must be calculated by comparing current nutrient levels with optimum levels of plant nutrients in the growing medium. The amount of each nutrient needed to obtain the optimum level of growth must be computed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Soil test results
Plant production manual

ENABLING OBJECTIVES:

1. Evaluate soil test results.
2. Recall plant nutrient names.
3. Look up the recommended growing media nutrient level.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
5. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.
6. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers and Publishers, Inc.
7. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley and Sons, Inc.

***RESOURCES:** (cont.)

8. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
9. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.
10. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.
11. Soil test results.
12. Checklist - Calculating fertilizer requirements.

TEACHING ACTIVITIES:

1. Present lecture on the importance of maintaining the optimum growing media nutrient levels. (* 1,2,3,4,5,6,7,8 & 9)
2. Show examples of soil test results. (* 11)
3. Question students on nutrient availability as affected by pH.
4. List resources available to help determine the optimum growing media nutrient levels. (* 1,2,3,4,5,6,7,8 & 9)
5. Assign students to look up the optimum growing media nutrient levels.
6. List discrepancies between the soil test results and the optimum growing media nutrient levels. (* 1,2,3,4,5,6,7,8,9 & 11)
7. Present lecture on figuring the amount and form of each nutrient needed to raise the current level to the optimum level. (* 1,2,3,4,5,6,7,8 & 9)
8. Assign each student a block of plants for which to calculate fertilizer requirements. (* 12)

CRITERION-REFERENCED MEASURE:

The student must list discrepancies between the soil test results and the optimum growing media nutrient levels and record the amount of each nutrient to be added. The recorded amount of each nutrient to be added must be enough to raise the growing media nutrient level to the optimum level without exceeding the optimum level by more than 10 percent.

PERFORMANCE GUIDE:

1. Obtain soil test results.
2. Identify current levels of plant nutrients in the growing medium.

PERFORMANCE GUIDE: (cont.)

3. Identify optimum levels of plant nutrients in the growing medium.
4. Compare optimum levels with current levels of nutrients in the growing medium.
5. Figure the amount of each nutrient needed to raise current level to the optimum level.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Calculate fertilizer requirements.

ENABLER

1. Evaluate soil test results.
2. Recall plant nutrient names.
3. Look up the recommended growing media nutrient level.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to calculate fertilizer requirements.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed current levels of plant nutrients in the growing medium.	____	____
2. Identified optimum growing media nutrient level for the plant.	____	____
3. Listed discrepancies between the optimum levels and the current levels of nutrients in the growing medium.	____	____
4. Calculated the amount and form of each nutrient needed to raise current level to the optimum level.	____	____

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 34

TASK: Incorporate fertilizer into growing media.

STANDARD OF PERFORMANCE OF TASK:

Fertilizer must be uniformly mixed into the growing medium at rate specified by soil test and plant growth requirements of particular plant species to be grown.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Site
Shovel
Soil mixer
Soil text
Fertilizer
Crop manual
Cultivation tool
Front-endloader

ENABLING OBJECTIVES:

1. Evaluate soil moisture content.
2. Recall units of measurement. (weight/volume)
3. Recall cultivation equipment safety.
4. Recall horticultural chemical safety.

***RESOURCES:**

1. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
3. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.
4. Cultivation equipment operating instructions.
5. Soil mixer operating instructions.
6. Checklist - Incorporating fertilizer into growing media.

TEACHING ACTIVITIES:

1. Present lecture on the types of fertilizer that can be incorporated into growing medium.
2. Question students on the soil moisture content optimum for cultivation or soil mixing. (* 1,2 & 3)
3. Discuss the importance of uniform application of fertilizer.
4. Discuss the importance of accuracy when measuring fertilizer.
5. Question students on horticultural chemical safety.
6. Question the students on cultivation equipment and/or soil mixing equipment safety.
7. Demonstrate how to use the cultivation equipment and/or soil mixing equipment. (* 4 & 5)
8. Assign a student to measure the fertilizer.
9. Assign a student to cultivate the site and/or operate the soil mixer.
10. Assign each student an area or an amount of growing media into which to incorporate fertilizer. (* 6)

CRITERION-REFERENCED MEASURE:

The student must check the soil moisture content, measure the fertilizer and mix the fertilizer with the growing media. The fertilizer must be uniformly mixed with moist growing media. All manufacturer's safety precautions must be followed.

PERFORMANCE GUIDE:

1. Combine fertilizer and the growing medium:
    A. Field or bed:
        1. Inspect site to determine if soil moisture is at a recommended level for cultivation.
        2. Apply specified amount of fertilizer uniformly to site.
        3. Cultivate site to uniformly mix fertilizer into topsoil.
           CAUTION: Follow manufacturer's recommendations and safety operations while operating cultivation equipment.
    B. Container:
        1. Apply specified amount to growing medium.
        2. Mix thoroughly.
           CAUTION: Follow manufacturer's recommendations and safety precautions while operating soil mixing equipment.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Incorporate fertilizer into growing media.

ENABLER

1. Evaluate soil moisture content.
2. Recall units of measurement. (weight/volume)
3. Recall cultivation equipment safety.

STUDENT'S NAME ______________________________ **DATE** __________

EVALUATOR'S NAME ____________________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to incorporate fertilizer into growing media.

PERFORMANCE DETERMINANTS	**YES**	**NO**
Field or bed:		
1. Inspected site to determine if soil moisture is at a recommended level for cultivation.		
2. Applied specified amount of fertilizer uniformly to site.		
3. Cultivated site.		
Container:		
4. Applied specified amount of fertilizer to growing medium.		
5. Mixed fertilizer with growing medium.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 35

TASK: Prepare mulch beds for storage of plant materials.

STANDARD OF PERFORMANCE OF TASK:

Mulch must be applied to bed at a depth that will cover the plant's root system, prevent temperature fluctuations, and aid in moisture retention.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Bed
Fork
Mulch
Plants
Shovel
Landscape ties

ENABLING OBJECTIVES:

1. Recall terms organic and inorganic.
2. Recall the effect of soil pH on plants.
3. Irrigate plants/planting beds.
4. Evaluate drainage characteristics of site.

***RESOURCES:**

1. Poincelot, R. (1986). No-dig, no-weed gardening. Emmaus, PA: Rodale Press.
2. Rice, R., Jr. (1986). Nursery and landscape weed control manual. Chicago, IL: American Nurseryman Publishing Co.
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Giles, F. (1986). Landscape construction procedures, techniques, and design. Champaign, IL: Stipes Publishing Co.

***RESOURCES:** (cont.)

5. Ingels, J. (1987). Landscaping: Principles and practices (3rd ed.). Albany, NY: Delmar Publishers Inc.
6. Checklist - Preparing mulch beds.

TEACHING ACTIVITIES:

1. Show examples of mulches.
2. Present lecture on the purpose(s) of mulch. (* 1,2,3,4 & 5)
3. Discuss the importance of selecting a well drained location.
4. List organic mulches.
5. List inorganic mulches.
6. Present lecture on changes in soil pH as mulch decomposes.
7. Present lecture on the recommended depth of the mulch layer for different mulches.
8. Present lecture on materials used for mulch bed borders. (* 4 & 5)
9. Show examples of mulch beds.
10. Assign each student an area in which to prepare a mulch bed. (* 6)

CRITERION-REFERENCED MEASURE:

The student must describe the drainage characteristics of the site, select the mulching material and apply the mulch. The student's description of the site's drainage characteristics must reflect those at the site (test administrator's judgment), the selected mulch must not alter the soil pH to the detriment of the plant and the mulch must cover the plants root system, prevent temperature fluctuation and aid in moisture retention.

PERFORMANCE GUIDE:

1. Select well drained area for mulch bed location.
2. Identify type of mulch.

PERFORMANCE GUIDE: (cont.)

- A. Organic mulch.
  NOTE: As hardwood bark decomposes, the pH rises. The pH of pine bark does not rise to the degree that hardwood bark does. Selection of mulch material should be made according to the pH requirements of the plants.
- B. Inorganic mulch.

3. Install border to retain the mulch, if desired.
4. Apply mulch to depth that will cover plant's entire root system.
5. Smooth the surface of the mulch bed.
6. Irrigate mulch bed.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Prepare mulch beds for storage of plant materials.

ENABLER

1. Recall terms organic and inorganic.
2. Recall the effect of soil pH on plants.
3. Irrigate plants/planting beds.
4. Evaluate drainage characteristics of site.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare mulch beds for storage of plant materials.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Selected well drained area for mulch bed location.	______	______
2.	Identified type of mulch.	______	______
3.	Installed border.	______	______
4.	Applied mulch.	______	______
5.	Covered plants' roots.	______	______
6.	Smoothed the surface of the mulch bed.	______	______
7.	Irrigated the mulch bed.	______	______

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 36

TASK: Haul topsoil.

STANDARD OF PERFORMANCE OF TASK:

Topsoil must be loaded and transported to specified location without spillage using specified equipment. Manufacturer's recommendations and safety precautions must be followed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Cart
Wagon
Truck
Shovel
Topsoil
Wheelbarrow
Front-endloader

ENABLING OBJECTIVES:

1. Recall motorized equipment safety.
2. Identify topsoil.
3. Estimate or weigh the amount of topsoil loaded.
4. Evaluate moisture content of topsoil.

***RESOURCES:**

1. Hannebaum, L. (1980). Landscape operations. Reston, VA: Reston.
2. Giles, F. (1986). Landscape construction procedures, techniques, and design. Champaign, IL: Stipes Publishing Co.
3. Ingels, J. (1987). Landscaping: Principles and practices (3rd ed.). Albany, NY: Delmar Publishers Inc.
4. Sunset Books. (1984). Landscaping illustrated. Menlo Park, CA: Lane Publishing Co.

***RESOURCES:** (cont.)

5. Ortho Books. (1980). All about landscaping. San Francisco, CA: Author.
6. Nursery/garden center catalog.
7. Equipment operating instructions.
8. Checklist - Hauling topsoil.

TEACHING ACTIVITIES:

1. Show examples of topsoil.
2. Question students on the characteristics of topsoil.
3. List sources of topsoil. (* 6)
4. Present lecture on costs of listed sources of topsoil. (* 6)
5. Present lecture on sources of topsoil that may contain pesticides.
6. Discuss the importance of excluding pesticides, trash or other contaminants from topsoil. (* 1,2,3,4, & 5)
7. Show examples of equipment used to haul topsoil. (* 7)
8. Discuss problems associated with loading wet topsoil.
9. Demonstrate how to load and haul topsoil.
10. Question students on the weight of the topsoil loaded.
11. Question students on motorized equipment safety.
12. Assign each student an amount of topsoil to haul. (*8)

CRITERION-REFERENCED MEASURE:

The student must load and transport the assigned amount of topsoil. The assigned amount of topsoil must be at the specified location (topsoil as defined by test administrator, free of trash, pesticides or other contaminates). All safety precautions must be followed and spillage must be avoided.

PERFORMANCE GUIDE:

1. Locate source to obtain topsoil.
   NOTE: Topsoil should be free from any traces of pesticides.
2. Load topsoil using specified equipment.
   CAUTION: All manufacturer's recommendations, weight restrictions, and safety precautions must be observed when operating equipment.

PERFORMANCE GUIDE: (cont.)

3. Transport topsoil to specified location.
   CAUTION: All manufacturer's recommendations and safety precautions must be observed.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Haul topsoil.

ENABLER

1. Recall motorized equipment safety.
2. Identify topsoil.
3. Estimate or weigh the amount of topsoil loaded.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to haul topsoil.

PERFORMANCE DETERMINANTS	YES	NO
1. Located source of topsoil.	_______	_______
2. Checked topsoil for traces of pesticides, trash or other contaminants.	_______	_______
3. Checked soil moisture content.	_______	_______
4. Loaded topsoil.	_______	_______
5. Transported topsoil to specified location.	_______	_______

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 37

TASK: Spread topsoil to establish a grade.

STANDARD OF PERFORMANCE OF TASK:

Topsoil must be spread uniformly to specified depth and slope and the site's surface must be uniform and smooth.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Site
Rake
Shovel
Dragmat
Topsoil
Tractor
Bulldozer
Site specifications

ENABLING OBJECTIVES:

1. Read landscape plan or other site specifications.
2. Calculate cubic feet.
3. Distinguish between areas higher or lower than a marked grade.

***RESOURCES:**

1. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Champaign-Urbana.
2. Giles, F. (1986). Landscape construction procedures, techniques, and design. Champaign, IL: Stipes Publishing Co.
3. Hannebaum, L. (1980). Landscape operations. Reston, VA: Reston.
4. Landscape plan.
5. Checklist - Spreading topsoil to establish a grade.

TEACHING ACTIVITIES:

1. Show area to be graded.
2. Show landscape plan or other site specifications. (* 4)
3. Present lecture on estimating the amount of soil required. (* 2 & 3)
4. Assign small groups to calculate the cubic feet of soil required.
5. Question students on the logical location to dump the soil.
6. Demonstrate how to load, move and/or dump the soil.
7. Demonstrate how to mark a grade. (* 1,2 & 3)
8. Assign students to identify areas lower than the marked grade.
9. Demonstrate how to separate clumps of soil.
10. Demonstrate how to move the clumps of soil into the low areas.
11. Demonstrate how to cover the clumps with fine soil.
12. Monitor the students as they practice loading, moving and/or dumping the topsoil.
13. Monitor the students as they practice filling low areas with clumps and fine soil.
14. Demonstrate how to smooth the topsoil.
15. Question students on rake and/or dragmat safety.
16. Monitor students as they practice smoothing the topsoil.
17. Assign each student an area on which to spread topsoil to establish a grade. (* 5)

CRITERION-REFERENCED MEASURE:

The student must calculate the topsoil needed, transport the topsoil to the site, and spread the topsoil to the specified depth and slope. The calculated amount of topsoil must be enough to complete the job but not exceed the required amount by 10% or 1 ton (including unused clumps). The depth and slope must be to specifications (plus or minus 1/2 inch) and there must be no soil clumps on the surface greater than 1/2" in diameter.

PERFORMANCE GUIDE:

1. Identify specifications for the depth of topsoil at the site.
2. Estimate amount of topsoil needed for the job.
3. Dump topsoil at specified location.

PERFORMANCE GUIDE: (cont.)

4. Grade the soil:
   CAUTION: All manufacturer's recommendations and safety precautions must be observed.
   A. Cover site uniformly with topsoil at specified depth and slope.
   B. Smooth topsoil to form a smooth surface with the specified slope.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Spread topsoil to establish a grade.

ENABLER

1. Read landscape plan.
2. Calculate cubic feet.
3. Distinguish between areas higher or lower than a marked grade.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME_____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist when evaluating student ability to spread topsoil to establish a grade.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Calculated amount of topsoil needed.	______	______
2.	Dumped topsoil in a logical location(s).	______	______
3.	Marked desired grade.	______	______
4.	Moved clumps of soil into low areas.	______	______
5.	Covered clumps of soil with fine soil.	______	______
6.	Filled all low areas.	______	______
7.	Removed soil from high areas.	______	______
8.	Smoothed the soil surface.	______	______
9.	Checked depth of soil.	______	______
10.	Checked slope of area.	______	______
11.	Cleaned and stored tools.	______	______

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 38

TASK: Incorporate compost.

STANDARD OF PERFORMANCE OF TASK:

Compost must be uniformly mixed with the soil on the site.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Site
Rake
Shovel
Compost
Rototiller
Manure spreader
Fertilizer spreader
Cultivating tool, mechanical or manual

ENABLING OBJECTIVES:

1. Recall cultivation equipment safety considerations.
2. Determine if compost has been incorporated.

***RESOURCES:**

1. Shewell, & Cooper. (1975). Compost gardening. New York, NY: Macmillan.
2. Minnich, J., & Hunt, M. (1979). Rodale guide to composting. Emmaus, PA: Rodale Press.
3. Checklist - Incorporating Compost.

TEACHING ACTIVITIES:

1. Show examples of composted materials.
2. List benefits of incorporating compost with soil. (* 1 & 2)
3. Outline procedures used to incorporate compost. (* 1 & 2)
4. Present lecture on soil moisture levels permissible when cultivating.
5. Show examples of soils with inadequate and/or excessive soil moisture.

TEACHING ACTIVITIES: (cont.)

6. Demonstrate how to spread compost.
7. Demonstrate how to check the depth of the compost.
8. Demonstrate how to incorporate the compost into the soil with cultivation equipment.
9. Monitor students as they practice spreading compost.
10. Question students on cultivation equipment safety considerations.
11. Monitor students as they practice incorporating the compost into the soil.
12. Assign each student an area in which to incorporate compost. (*3)

CRITERION-REFERENCED MEASURE:

The student must check the soil moisture level, spread compost and incorporate the compost into the soil. The must be uniformly mixed with the soil (any two samples are the same percentage compost, plus or minus five percent and there are no clumps of soil or compost larger than 1 inch).

PERFORMANCE GUIDE:

1. Inspect site to determine if soil moisture is at a recommended level for cultivation.
2. Spread compost uniformly over specified site at specified rate.
3. Cultivate site to mix compost with soil.
   CAUTION: Follow all manufacturer's recommendations and safety precautions while operating cultivation equipment.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Incorporate compost.

ENABLER

1. Evaluate soil moisture content.
2. Recall cultivation equipment safety considerations.
3. Determine if compost has been incorporated.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to incorporate compost.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Checked soil moisture level.		
2.	Spread compost.		
3.	Checked depth of compost.		
4.	Performed cultivation equipment prestart procedures.		
5.	Incorporated compost.		
6.	Determined if compost was incorporated.		
7.	Cleaned and stored tools and equipment.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 39

TASK: Perform soil erosion control practices.

STANDARD OF PERFORMANCE OF TASK:

Erosion control practices must meet Soil Conservation Service standards and specifications.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Site
Mulch
Survey equipment
Tillage equipment
Soil moving equipment
Soil Conversation Service (SCS) assistance

ENABLING OBJECTIVES:

1. Determine if erosion control practices meet soil conservation service specifications.
2. Recall units of measurement.

***RESOURCES:**

1. Bosworth, D., & Foster, A. (1982). *Approved practices in soil conservation*. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Bennett, C. (1983). *Conservation and management of natural resources in the United States*. Somerset, NJ: John Wiley and Sons, Inc.
3. Donahue, R., Follett, R., & Tulloch, R. (1983). *Our soils and their management*. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Schwab, G., Frevert, R., Edminister, T., & Barnes, K. (1981). *Soil and water conservation engineering* (3rd ed.). Somerset, NJ: John Wiley and Sons, Inc.
5. Checklist - Performing soil erosion control practices.

TEACHING ACTIVITIES:

1. Show examples, photos or diagrams of soil erosion.
2. List causes of erosion. (* 1,2,3 & 4)
3. Discuss the importance of controlling soil erosion.
4. Present lecture on methods used to control soil erosion. (* 1,2,3 & 4)
5. Show examples of soil conservation service recommendations.
6. List tools, equipment and materials needed to perform the recommended soil erosion control procedure.
7. Present lecture on scheduling of soil erosion control procedures.
8. Question students on whether the soil erosion control practice meets the Soil Conservation Service specifications.
9. Assign each student a soil erosion control procedure to perform. (*5)

CRITERION-REFERENCED MEASURE:

The student must read the Soil Conservation Service recommendations, schedule the soil erosion control practices, perform the soil erosion control practices and determine if the soil erosion control practices meet Soil Conservation Service standards and specifications. The soil erosion control practices must meet Soil Conservation Service standards and specifications.

PERFORMANCE GUIDE:

1. Consult Soil Conservation Service for assistance in developing a plan to reduce soil erosion at particular site.
2. Identify practices that reduces erosion and conform to growing operations:
   A. Agronomic practices:
      1. Conservation cropping system.
      2. Conservation tillage system.
      3. Contour farming.
      4. Cover and green manure crop.
      5. Critical area planting.
      6. Crop residue use.
      7. Field border.
      8. Mulching.
      9. Strip cropping on the contour.

PERFORMANCE GUIDE: (cont.)

- B. Engineering practices:
    - 1. Diversion.
    - 2. Grade stabilization structure.
    - 3. Grassed waterway or outlet.
    - 4. Lined waterway or outlet.
    - 5. Irrigation water management.
    - 6. Pond.
    - 7. Sediment basin.
    - 8. Water and sediment control basin.

3. Install soil erosion control practices for site:
    - A. Apply agronomic practices to control soil erosion:
        - 1. Obtain recommendation and specifications for the implementation of specified agronomic practices.
        - 2. Implement agronomic practices.
    - B. Install engineering practices to control soil erosion:
        - 1. Obtain design specifications from Soil Conservation Service.
        - 2. Survey the site.
        - 3. Construct the specified practices at the site.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Perform soil erosion control practices.

ENABLER

1. Determine if erosion control practices meet Soil Conservation Service specifications.

STUDENT'S NAME________________________ **DATE**__________

EVALUATOR'S NAME________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to perform soil erosion control practices.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Identified soil erosion control practices to be performed from Soil Conservation Service recommendations.	______	______
2. Scheduled soil erosion control practices in logical order.	______	______
3. Performed soil erosion control practices.	______	______
4. Determined if soil erosion control practices met Soil Conservation Service Standards and specifications.	______	______

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 40

TASK: Prepare seedbed.

STANDARD OF PERFORMANCE OF TASK:

Seedbed must be cultivated to a depth of 3-6 inches. Soil disinfestation operations must be completed and organic matter, starter fertilizer, and pre-plant herbicide added, to meet the recommended environmental conditions for particular plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Organic matter
Lime
Starter fertilizer
Sulfur
Pre-plant herbicide
Seedbed
Chemical soil sterilants
Soil pasteurization system

ENABLING OBJECTIVES:

1. Recall the purpose of a seedbed.
2. Recall common types of organic matter soil amendments and the advantages and/or disadvantages of each.
3. Identify a starter fertilizer.
4. Comprehend the concept of soil pH, and the implications of soil pH to a seedbed.
5. Select pre-plant herbicide for a particular plant species.

***RESOURCES:**

1. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.

*RESOURCES: (cont.)

3. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Ware, G. (1980). Complete guide to pest control. Fresno, CA: Thompson Publications.
6. Page, B., & Thomson, W. (1987) Insecticide, herbicide, fungicide quick guide. Fort Atkinson, WI: Nasco.
7. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
8. Haskell, P. (1985). Pesticide application: Principles and practices. New York, NY: Oxford University Press.
9. Yepsen, R., Jr. (1984). The encyclopedia of natural insect and disease control. Emmaus, PA: Rodale Press.
10. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley and Sons, Inc.
11. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
12. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.
13. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
14. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
15. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
16. Checksheet - Preparing seedbeds.

TEACHING ACTIVITIES:

1. Discuss the importance of the seedbed soil conditions for seed germination.
2. Show examples of soil.
3. Question students about the suitability of a variety of soil for a seedbed.
4. Show examples of soil amendments.
5. Question students about the suitability of a variety of soil amendments for improving the soil texture of a seedbed.
   (* 1,2,3,4,11,12,13,14 & 15)
6. Present lecture on disinfestation safety and procedures.

TEACHING ACTIVITIES: (cont.)

7. Present lecture on application of starter fertilizers. (* 1,2,3 & 4)
8. Present lecture on adjusting the soil pH. (* 10,11 & 12)
9. Present lecture on pre-plant herbicide safety and application. (* 5,6,7,8 & 9)
10. Present the factors to consider when deciding the degree of disinfestation required.
11. Demonstrate disinfestation procedures.
12. Demonstrate application of starter fertilizers.
13. Demonstrate adjustment of the soil pH.
14. Demonstrate application of pre-plant herbicides.
15. Assign each student a seedbed to prepare. (* 16)

CRITERION-REFERENCED MEASURE:

The student must cultivate, amend and pasteurize the soil to prepare a seedbed. The seedbed soil must be pasteurized homogenous and exhibit texture, pH, nutrient and pre-plant herbicide content and cultivation depth appropriate for the particular plant species.

PERFORMANCE GUIDE:

1. Cultivate seedbed to a depth of 3-6 inches.
2. Add organic matter to improve soil texture, if needed.
3. Disinfest the seedbed to control soil insects, disease, and weed seeds, if needed.
   CAUTION: Follow manufacturer's recommendations and safety precautions for pasteurization operations.
4. Apply starter fertilizer.
5. Adjust pH of growing media, if needed.
6. Apply pre-plant herbicide if recommended for particular plant species and environmental conditions.
7. Incorporate organic matter, fertilizer, lime or sulfur, and herbicide.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Prepare seedbed.

ENABLER

1. Recall the purpose of a seedbed.
2. Identify a starter fertilizer.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use this checklist to evaluate a students ability to prepare a seedbed.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Cultivated seedbed.		
2. Removed any foreign matter from soil.		
3. Selected soil amendments.		
4. Selected amount of each soil amendment to add:		
- Organic matter.		
- Starter fertilizer.		
- Pre-plant herbicide.		
- Lime/sulfur.		
5. Added organic matter.		
6. Followed manufacturers recommendations and safety precautions for pasteurization operations.		
7. Added other soil amendments.		
8. Incorporated soil amendments.		

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 41

TASK: Aerate sod.

STANDARD OF PERFORMANCE OF TASK:

Compacted soils must have plugs removed or holes punched in the soil to provide aeration. Surface plugs must be gathered or broken up. Sod must be irrigated immediately after aeration process.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Spiker
Slicer
Drag mat
Core cultivator
Compacted turf site
Subsurface cultivator

ENABLING OBJECTIVES:

1. Recall motorized equipment safety.
2. Evaluate soil moisture content.
3. Irrigate turfgrass.
4. Determine if the turfgrass species can be aerated without excessive damage to the turfgrass.

***RESOURCES:**

1. Conover, H. (1958). Grounds maintenance handbook (3rd ed.). Fort Worth, TX: Branch-Smith Publishing.
2. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Champaign-Urbana.
3. Turgeon, A. (1980). Turf grass management. Reston, VA: Reston.
4. Sprague, H. (1982). Turf management handbook. Fort Worth, TX: Branch-Smith Publishing.
5. Daniel, W., & Freeborg, R. (1980). Turf managers' handbook. Cleveland, OH: Harvest.

*RESOURCES: (cont.)

6. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
7. Aerator equipment operating instructions.
8. Checklist - Aerating sod.

TEACHING ACTIVITIES:

1. Present lecture on reasons why non-compacted soil is desirable. (* 1,2,3,4,5 & 6)
2. Outline procedures used to aerate sod.
3. Present lecture on procedures used to aerate sod.
4. Present lecture on the time of year to aerate warm season grasses and cool season grasses. (* 1,2,3,4,5 & 6)
5. Discuss the importance of aerating sod when the moisture content of the soil is optimum.
6. Discuss the importance of immediate irrigation of sod after aeration procedures.
7. Question student on aerator safety.
8. Demonstrate how to start the aerator. (* 7)
9. Demonstrate how to operate the aerator. (* 7)
10. Monitor students as they practice using the aerator.
11. Demonstrate how to dispose of the soil plugs and/or any other refuse.
12. Monitor the students as they practice disposing of the soil plugs and/or any other refuse.
13. Assign each student an area of sod to aerate. (* 8)

CRITERION-REFERENCED MEASURE:

The student must determine if the sod can be aerated without excessive damage to the turfgrass species, operate the aerator, dispose of or disperse the soil plugs and/or other refuse and irrigate the sod if needed. The sod must exhibit non-compacted areas, be free of unwanted soil plugs or other refuse and contain soil moisture adequate for turfgrass species (sod does not wilt).

PERFORMANCE GUIDE:

1. Plan aeration operation on compacted soils for suitable season of year:
   A. Aerate warm season turf in late spring or early fall.
   B. Aerate cool season turf in late summer or early fall.

PERFORMANCE GUIDE: (cont.)

2. Check moisture level of soil at site.
3. Aerate soil when moisture level is at a medium level.
   NOTE: Performing aeration operations on wet soils may damage turf, while aeration on dry soils is difficult.
4. Operate mechanical cultivator according to manufacturer's recommendations and safety precautions:
   A. Core cultivation:
      1. Use core cultivator to remove soil plugs.
      2. Remove soil plugs:
         a. Gather soil plugs mechanically or by raking.
         b. Break up soil plugs with a drag mat.
   B. Other methods:
      1. Use spiker to punch holes into the soil without removing plugs.
      2. Use slicer to cut slits through turf.
      3. Use subsurface cultivator to shatter a compacted layer.
         NOTE: Subsurface cultivation can seriously disturb the surface.
5. Irrigate site immediately after mechanical cultivation.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Aerate sod.

ENABLER

1. Determine if the turfgrass species can be aerated without excessive damage to the turfgrass.
2. Recall aerator safety precautions.
3. Irrigate turfgrass.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to aerate sod.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Determined if the sod could be aerated without excessive damage to the turfgrass species.	______	______
2.	Identified soil moisture level.	______	______
3.	Started and operated the aerator safely.	______	______
4.	Removed specified amount of soil plugs or punched specified amount of holes.	______	______
5.	Disposed of or dispersed the soil plugs and/or other refuse.	______	______
6.	Assessed sod irrigation needs.	______	______
7.	Irrigated the sod.	______	______

DUTY: PREPARING SOIL AND GROWING MEDIA

PERFORMANCE OBJECTIVE NO. 42

TASK: Top dress lawn.

STANDARD OF PERFORMANCE OF TASK:

The top dressing material must be identical to existing topsoil or have previously been used as top dressing material. The top dressing material must be spread to a depth of no greater than 1/4 inch and worked into the thatch.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Illinois Lawn Care and Establishment.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Drag mat
Top dresser
Fertilizer spreader
Top dressing material

ENABLING OBJECTIVES:

1. Recall the effects of a compacted soil on turfgrass.
2. Identify the type of top dressing material to use.
3. Identify actively growing and dormant turfgrass.
4. Identify thatch.

***RESOURCES**

1. Conover, H. (1958). Grounds maintenance handbook (3rd ed.). Fort Worth, TX: Branch-Smith Publishing.
2. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Champaign-Urbana.
3. Turgeon, A. (1980). Turf grass management. Reston, VA: Reston.
4. Sprague, H. (1982). Turf management handbook. Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

5. Daniel, W., & Freeborg, R. (1980). Turf managers' handbook. Cleveland, OH: Harvest.
6. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
7. Fertilizer spreader calibration instructions.
8. Top dresser calibration instructions.
9. Checklist - Top dressing a lawn.

TEACHING ACTIVITIES:

1. Outline procedures used to top dress a lawn. (* 1,2,3,4,5 & 6)
2. Question students on negative and positive effects of top dressing an area of actively growing and/or dormant turfgrass.
3. Show samples of a variety of top dressing materials.
4. Present lecture on the benefits of top dressing turfgrass growing on compacted soil. (* 1,2,3,4,5 & 6)
5. Present lecture on negative effects of applying top dressing materials of different textures in alternating layers. (* 1,2,3,4,5 & 6)
6. Question students on selection of top dressing material for a variety of soil textures.
7. Present lecture on calibration and operation of a fertilizer spreader and/or top dresser. (* 7 & 8)
8. Demonstrate the calibration of a fertilizer spreader and/or top dresser. (* 7 & 8)
9. Demonstrate how to apply top dressing material.
10. Demonstrate how to check the depth of the top dressing material that has been applied.
11. Demonstrate the use of a drag mat.
12. Demonstrate how to check if the top dressing material has been worked into the thatch.
13. Monitor students as they practice calibrating a fertilizer spreader and/or top dresser.
14. Monitor students as they practice applying the top dressing material.
15. Monitor students as they practice using a drag mat.
16. Assign each student an area of turfgrass to top dress. (* 9)

CRITERION-REFERENCED MEASURE:

The student must select the optimum top dressing material, apply the top dressing material and work the top dressing material into the thatch. The selected top dressing material must be identical to the existing topsoil, identical to the previously

CRITERION-REFERENCED MEASURE: (cont.)

used top dressing material or a sandy soil applied to a fine textured soil. The applied layer of top dressing material must be 1/8-1/4 inch thick and worked into the thatch (less than 5% of the assigned area has an unmixed layer of the top dressing material thicker than 1/8 inch).

PERFORMANCE GUIDE:

1. Select top dressing material:
   A. Use a top dressing material identical to top soil on site if topsoil has desirable characteristics.
   B. Use sandy soil to top dress a fine-textured soil to improve texture.
      CAUTION: Once a coarser material is used to top dress the site, only that material can be used on subsequent top dressings.
2. Spread a thin layer, less than 1/4 inch, of top dressing material over site when turfgrass is actively growing.
3. Work top dressing material into thatch with drag mat.

CHECKLIST

DUTY Preparing Soil and Growing Media

TASK Top dress lawn.

ENABLER

1. Select top dressing material.
2. Calibrate and operate a fertilizer spreader or top dresser.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to top dress a lawn.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected top dressing material.	______	______
2.	Calibrated fertilizer spreader or top dresser.	______	______
3.	Applied a thin layer (1/4 inch) of the top dressing material.	______	______
4.	Worked the top dressing material into the thatch.	______	______
5.	Checked the extent that the top dressing material was worked into the thatch.	______	______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 43

TASK: Test seeds for germination percentage.

STANDARD OF PERFORMANCE OF TASK:

A representative sample of a specified seed lot must be kept moist and exposed to optimum germination temperature for specified species. A daily record of the number of seeds germinated must be kept. Germination percentage must be calculated after test has been terminated.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Petri dishes
Filter paper
Plastic wrap or bags
Seeds
Absorbent paper toweling

ENABLING OBJECTIVES:

1. Read and interpret seed lot label information.
2. Identify materials used for germination testing.
3. Separate single seeds from groups of seeds or foreign matter.
4. Identify moisture content.
5. Use calculator to add, subtract, multiply and/or divide.

***RESOURCES:**

1. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
2. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
3. Harness & D'Angelo. (1987). The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.

***RESOURCES:** (cont.)

4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
5. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
6. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
7. Checksheet - Testing seeds for germination percentage.

TEACHING ACTIVITIES:

1. Discuss the importance of seed lot germination testing.
2. Outline overall procedures used to perform a germination test. (* 1,2,3,4,5 & 6)
3. Show examples of materials used in germination test.
4. Present lecture on environmental conditions required for germination. (* 1,2,3,4,5 & 6)
5. Present lecture on avoiding contamination of seeds and seedlings while performing germination tests. (* 1,2,3,4,5 & 6)
6. Demonstrate how to place seeds in petri dish or paper toweling.
7. Present lecture on characteristics of germinated seeds and ungerminated seeds. (* 1,2,3,4,5 & 6)
8. Present lecture on characteristics of normal seedlings and abnormal seedlings. (* 1,2,3,4,5 & 6)
9. Show examples of germinated seeds, ungerminated seeds, normal seedlings, abnormal seedlings.
10. Question students on identification of germinated seeds, ungerminated seeds, normal seedlings and abnormal seedlings.
11. Present lecture on calculation of germination percentages.
12. Question students on maintenance of optimum germination environment.
13. Assign each student seeds for which to test germination percentages. (* 7)

CRITERION-REFERENCED MEASURE:

The student must count the seeds,follow procedure for placing seed in petri dish or paper toweling, maintain the optimum germination environment, record the number of and calculate the percentage of normal and abnormal germinated seeds. The germination rate must be equal to (plus or minus 10%) the germination rate established for the seed lot, the calculated percentages must reflect the counted frequencies and all seeds must be accounted for.

PERFORMANCE GUIDE:

1. Select seed lot of desired plant species.
2. Count out an even number of seeds to use and perform germination test:
   A. Petri dish germination test:
      1. Place two pieces of filter paper in the bottom of a sterilized petri dish.
      2. Place an even number of seeds from the same seed lot in the petri dish.
      3. Cover the seeds with a piece of filter paper.
      4. Moisten filter paper thoroughly with deionized water.
      5. Pour off any excess water.
      6. Place lid on petri dish.
      7. Place petri dish where germination temperature is optimum for particular plant species.

   B. Rolled towel germination test:
      1. Obtain 2 sheets of paper toweling.
      2. Thoroughly moisten the paper toweling.
      3. Start rolling the paper toweling lengthwise.
      4. Sow an even number of seeds from the same seed lot in a row along the roll.
      5. Finish rolling the paper toweling.
      6. Place the roll in a plastic bag or wrap with plastic wrap.
      7. Add additional water to paper toweling if needed to keep it moist.
3. Count the number of seedlings which have germinated after the first week or required time period.

PERFORMANCE GUIDE: (cont.)

4. Record the number of normal and abnormal seedlings.
5. Discard seedlings that have been recorded.
6. Repeat steps 3, 4, and 5 at regular intervals.
7. Terminate experiment after established germination period for particular species has elapsed.
8. Calculate germination percentages using the following formula: Number of normal seedlings divided by number of seeds = rate of germination X 100 = germination percentage.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Test seeds for germination percentage.

ENABLER

1. Read and interpret seed lot label information.
2. Identify materials used for germination testing.
3. Separate single seeds from groups of seeds or foreign matter.
4. Identify moisture content.
5. Use calculator to add, subtract, multiply and/or divide.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to test seeds for germination percentage.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified the specified seed lot to be tested.	_______	_______
2.	Counted out an even number of seeds.	_______	_______
3.	Followed procedures for placing seeds in petri dish or paper toweling.	_______	_______
4.	Avoided contamination of the seeds and seedlings.	_______	_______
5.	Maintained the optimum germination environment.	_______	_______
6.	Recorded the number of normal and abnormal germinated seeds.	_______	_______
7.	Discarded germinated seeds.	_______	_______
8.	Calculated the percentages of normal and abnormal germinated seeds.	_______	_______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 44

TASK: Sow seeds.

STANDARD OF PERFORMANCE OF TASK:

Seeds must be sown uniformly at recommended rate, depth, and planting date for particular plant species, system, and method of sowing. The medium must make good contact with the seed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Seeds
Seeder
Roller
Seedbed
Hoe
Drill
Labels
Planter
Disinfested pots
Disinfested flats
Pasteurized propagating media

ENABLING OBJECTIVES:

1. Collect information about a plant from reference materials.
2. Irrigate and/or mist seed beds, flats and/or containers.

***RESOURCES:**

1. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
2. Harness & D'Angelo. (1987). The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.
3. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.

***RESOURCES:** (cont.)

4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
5. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
6. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
7. Shumack, R., & Williams, G. (1983). Greenhouse flowers and bedding plants. Danville, IL: The Interstate Printers and Publishers, Inc.
8. Seed catalog.
9. Seed package label.
10. Mechanical seeding equipment operating instructions.
11. Checklist - Sowing seeds.

TEACHING ACTIVITIES:

1. List plants that are typically grown from seed. (* 1,2,3 & 4)
2. List plants that are typically direct sown and plants that are typically transplanted. (* 1,2,3 & 4)
3. Show examples of equipment used in mechanical seeding operations.
4. List environmental conditions required for seed germination and growth. (* 1,2,3,4,5,6,7,8 & 9)
5. Show examples of reference materials used to determine planting dates and/or germination requirements. (* 1,2,3,4,5,6,7,8 & 9)
6. Present lecture on determining the planting date for a specific species. (* 4,5,6 & 7)
7. Present lecture on determining whether seeds will be directly sown or transplanted. (* 1,2,3,4,5,6,7,8 & 9)
8. Assign a student to look up the germination temperatures, seeding depth and light requirements for a specific species. (* 1,2,3,4,5,6,7,8 & 9)
9. Show examples of ground beds, containers and/or flats that are ready for seeding.
10. Demonstrate how to set the seeding rate on a mechanical seeder. (* 10)
11. Demonstrate how to operate the mechanical seeder. (* 10)
12. Monitor students as they practice setting the seeding rate on a mechanical seeder.
13. Monitor students as they practice operating a mechanical seeder.

TEACHING ACTIVITIES: (cont.)

14. Demonstrate how to sow seeds manually. (* 1,2,3 & 4)
15. Monitor students as they practice sowing seeds manually.
16. Discuss the importance of labeling newly sown seeds.
17. Assign a student to irrigate or mist the newly sown seeds.
18. Assign each student a plant species for which to sow the seeds. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the system of sowing the seed, the planting date, the seeding depth, the seeding rate, the temperature and light requirements for germination, sow the seeds manually or using a mechanical seeder, label the newly sown seeds and irrigate or mist the newly sown seeds. The listed information must be the same as is recommended in the reference materials. The seeds must be sown uniformly at the recommended rate and depth for the particular plant species, system and method of sowing and the medium must make good contact with the seed.

PERFORMANCE GUIDE:

1. Identify the particular species or cultivar that will be sown.
2. Identify recommended planting date for the specific species sown.
3. Identify the recommended germination temperatures for the specific species sown.
4. Identify the recommended seeding depth for the specific species sown:
   - A. Check seed package or reference for recommended seeding depth.
   - B. Sow seeds at approximately 3-4 times the diameter of the seed.
     NOTE: Very fine seeds are generally not covered with medium.
   - C. Expose seeds which require light for germination by either covering them lightly with medium or not at all.
     CAUTION: Seeds planted too shallow may dry out too quickly. Seeds planted too deep may be delayed in emergence.

PERFORMANCE GUIDE: (cont.)

5. Identify the system to be used in sowing seed:
    - A. Direct seeding system.
    - B. Transplant system.
6. Identify the recommended seeding rate for the specific species sown:
    - A. Set seeding rate for seeds sown by the direct seeding system at final spacing.
    - B. Set seeding rate for seeds sown by the transplant system at propagation spacing
7. Seed planting location:
    - A. Ground beds:
        - 1. Inspect the prepared seedbed to insure its readiness:
            - a. Check moisture content.
            - b. Determine if cultivation has been completed.
            - c. Determine if fertilizer/amendment operations have been completed.
            - d. Determine if soil disinfestation operations have been completed.
        - 2. Place seed in seedbed:
            - a. Mechanical:
                - 1. Use mechanical seeder, drill, or planter to plant seed.
                - 2. Follow manufacturer's recommendations and safety precautions in setting and operating mechanical seeders, drills, or planters.
            - b. Manual:
                - 1. Select method to use:
                    - a. Place the seeds in furrows using the row method.
                    - b. Broadcast the seeds over the seedbed using the broadcast method.
                - 2. Cover seed with soil at recommended depth for plant species.
                - 3. Firm soil around seed.

                  Note: Seed must be in close contact with soil particles.
    - B. Containers or flats:
        - 1. Fill disinfested containers or flats with moistened and/or pasteurized propagating medium.

          Note: Containers and flats may be filled mechanically.

PERFORMANCE GUIDE: (cont.)

        2. Firm medium in containers or flats.
        3. Plant seed uniformly:
            a. Mechanical:
                1. Use seed that germinates at nearly 100 percent germination rate.
                2. Follow manufacturer's recommendations and safety precautions in selecting seed species, and in setting, and operating mechanical seeders.
            b. Manual:
                1. Select method to use:
                    a. Plant seed in furrows across the width of flat using the row method.
                    b. Broadcast the seed over the medium using the broadcast method.
                    c. Plant individual seeds directly in individual containers using one method of direct seeding.
                2. Cover seed with medium at recommended depth for plant species.
    8. Label each species or variety sown with cultivar species, and planting date.
    9. Water gently with a fine mist, if practical.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Sow seeds.

ENABLER

1. Collect information about a plant from reference materials.
2. Irrigate and/or mist seed beds, flats and/or containers.

STUDENT'S NAME ______________________________ **DATE** __________

EVALUATOR'S NAME ______________________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to sow seeds.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Checked the recommended planting date.	_______	_______
2.	Checked seeding depth.	_______	_______
3.	Checked the temperature requirements.	_______	_______
4.	Checked the light requirements.	_______	_______
5.	Prepared seeding flat, container or ground bed.	_______	_______
6.	Sowed seed at listed depth.	_______	_______
7.	Labeled sowed seeds.	_______	_______
8.	Misted or irrigated.	_______	_______
9.	Placed flats, container on germination area.	_______	_______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 45

TASK: Stratify seeds.

STANDARD OF PERFORMANCE OF TASK:

Seeds must be fully imbibed with water. The seeds must be exposed to cool-moist temperatures, approximately 0°-10°C (32°-50°F), or to alternate periods of warm and cold if specified for particular plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Seeds
Water
Screens
Moisture retaining media
Container or polyethylene bags
Refrigerator or winter conditions

ENABLING OBJECTIVES:

1. Measure temperature
2. Measure time (minutes/hours/days).
3. Evaluate moisture content of medium.
4. Collect information about a plant from reference materials.

***RESOURCES:**

1. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
2. Harness & D'Angelo. (1987). The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.
3. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.

*RESOURCES: (cont.)

5. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
6. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
7. Shumack, R., & Williams, G. (1983). Greenhouse flowers and bedding plants. Danville, IL: The Interstate Printers and Publishers, Inc.
8. Checklist - Stratifying seeds.

TEACHING ACTIVITIES:

1. Outline steps used to stratify seeds. (* 1,2,3,4,5,6 & 7)
2. List plant species that require stratification before germination can occur. (* 1,2,3,4,5,6 & 7)
3. Present lecture on the natural survival mechanism aspect of seed stratification requirement. (* 1,2,3 & 4)
4. Present lecture on scarifying and/or soaking seeds so that the seeds become imbibed with water. (* 1,2,3 & 4)
5. Present lecture on the temperatures that satisfy stratification requirements. (* 1,2,3,4,5,6 & 7)
6. Present lecture on the duration of the stratification treatment. (* 1,2,3,4,5,6 & 7)
7. Show examples of references materials used to determine stratification requirements. (* 1,2,3,4,5,6 & 7)
8. Assign students to look up stratification temperatures and duration required by a particular plant species. (* 1,2,3,4,5,6 & 7)
9. Demonstrate how to soak the seeds. (* 1,2,3,4 & 5)
10. Discuss the importance of aerating the seeds while they are being soaked. (* 1,2,3 & 4)
11. Show examples of seeds that are imbibed with water.
12. Show examples of media with high moisture retaining properties.
13. Demonstrate how to mix the seeds with the medium.
14. Question students on what information should be put on the seed label.
15. Assign students to label the seeds.
16. Question students on how to provide cool temperatures.
17. Assign students to check the moisture content of the medium periodically.
18. Assign each student a plant species for which to stratify the seeds. (* 8)

CRITERION-REFERENCED MEASURE:

The student must determine and record the stratification temperature and duration, moisten the seeds in water, mix the seeds with moist medium, label the seeds, place the seeds where cool temperatures will be provided, check and remoisten the medium as needed and remove the seeds after the specified length of time. The recorded information must be the same as is recommended in the reference materials. The seeds must be fully imbibed with water, exposed to the recommended temperature for the recommended duration and not allowed to dry out at any time.

PERFORMANCE GUIDE:

1. Select plant species that require stratification before germination can occur.
2. Check seed package label or other reference to determine temperature and duration required by particular plant species.
3. Moisten seeds in water:
   A. Soak seeds in warm water:
      NOTE: Seeds without hard seed coats or coverings are generally soaked for 12-24 hours. Seeds with hard endocarp or pericarp are either scarified first or soaked in water with aeration for 3-7 days or longer.
      1. Aerate seeds every 12 hours by changing the water in which seeds are being soaked.
      2. Remove seeds from water after they are fully imbibed with water.
      3. Select a moisture-retaining medium for stratification period.
      4. Moisten medium.
         CAUTION: Medium should be moist but not so wet that water can be squeezed out of it.
      5. Place medium in containers, raised beds, or pits which will provide aeration, prevent drying, and provide rodent protection.

   B. Plant seeds outdoors early in fall so the seed will be fully imbibed with water from natural rainfall/irrigation, before cold weather occurs.

PERFORMANCE GUIDE: (cont.)

4. Mix seeds with the medium at a ratio of 1-3 parts of medium to 1 part seed for the stratification period.
5. Place seeds at 0°-10° C (32°-50° F) for stratification as specified for particular plant species:
    - A. Refrigerator unit may be used to provide cool temperatures.
    - B. Outdoor stratification may be utilized where natural temperatures will provide required temperatures for duration of stratification period.
6. Examine seeds periodically.
7. Remoisten medium if it dries out.
8. Remove seeds from medium after specified length of treatment for particular species.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Stratify seeds.

ENABLER

1. Measure temperature.
2. Measure time (minutes/hours/days).
3. Evaluate moisture content of media.
4. Collect information about a plant from reference materials.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to stratify seeds.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Listed stratification temperature.		
2.	Listed duration for stratification.		
3.	Soaked seeds in warm water.		
4.	Aerated seeds every 12 hours.		
5.	Removed seeds from water after they were fully imbibed with water.		
6.	Selected a moisture-retaining medium for stratification period.		
7.	Moistened medium.		
8.	Placed medium in containers, raised beds, or pits which provided aeration.		
9.	Kept seeds at optimal moisture level.		
10.	Protected seeds from rodents.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 46

TASK: Scarify seeds.

STANDARD OF PERFORMANCE OF TASK:

The seed covering must be made permeable to water and gases without damage to seed embryo.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

File
Screens
Hand lens
Sandpaper
Reference manual
Seeds
Hammer
Hot water
Glass funnels
Sulfuric acid
Mechanical scarifier
Coarse sand or gravel
Glass, earthenware, or wooden container

ENABLING OBJECTIVES:

1. Look up scarification recommendations.
2. Measure temperature.
3. Recall general equipment and hand tool safety.
4. Recall horticultural chemical safety.

***RESOURCES:**

1. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
2. Harness & D'Angelo. (1987). The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.
3. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.

***RESOURCES:** (cont.)

4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
5. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
6. Checklist - Scarifying seeds.

TEACHING ACTIVITIES:

1. Question students on germination requirements.
2. Present lecture on the structure of a seed. (* 1,2,3,4 & 5)
3. List plants that require scarification before germination can occur. (* 1,2,3,4 & 5)
4. List references used to determine the recommended method of scarification.
5. List methods used to scarify seeds.
6. Show examples of seeds before and after scarification.
7. Demonstrate how to scarify seeds mechanically, using hot water and using acid. (* 1,2,3,4 & 5)
8. Discuss the importance of avoiding injury to the seed.
9. Question students on safety considerations when scarifying seeds.
10. Assign each student a package of seeds to scarify. (* 6)

CRITERION-REFERENCED MEASURE:

The student must record the recommended scarification method and scarify the seeds. The recorded scarification method must be the same as what is recommended in the resource materials, the seed coat must be made permeable to water and gases without damage to the seed embryo (germination rate is the same as seeds from the same seed lot scarified by the test administrator, plus or minus 5 %).

PERFORMANCE GUIDE:

1. Select seed of plant species which require scarification before germination can occur.
2. Check seed package label or other reference to find the recommended method of scarification to use on particular species.

PERFORMANCE GUIDE: (cont.)

3. Remove hard seed coat:
   - A. Mechanical Scarification:
     1. Place test lot of dry seed in a mechanical scarifier.
     2. Scratch seed until hard seed coat is removed which generally results in a dull colored seed.

        CAUTION: The scarification process must end before the seeds are injured. Generally the seeds should not be cracked or deeply pitted.
     3. Check scarified seed by examining seed with a hand lens, soaking seed in warm water to observe seed swelling, or by germinating the seed.
     4. Adjust scarification time as needed.
     5. Repeat above steps with rest of seed lot.
   - B. Hot water scarification:
     1. Heat water to a temperature of 77°-100° C (170°-212° F).

        NOTE: Use a ratio of 4-5 parts water to one part seed.
     2. Drop seed into hot water.
     3. Remove water/seed mixture from heat source immediately.
     4. Allow water to cool gradually.
     5. Soak seed for 12-24 hours.
     6. Separate swollen seed from unswollen seed using screens.
     7. Retreat seed that have not swelled.
   - C. Acid scarification:
     1. Place test lot of dry seed in glass, earthenware, or wooden container.
     2. Cover seed with concentrated sulfuric acid at a ratio of 2 parts acid to 1 part seed.

        CAUTION: Add the sulfuric acid to water instead of adding water to the sulfuric acid in order to work with the least concentrated solution.

        CAUTION: All safety precautions must be observed when working with sulfuric acid. Protective clothing worn by worker must include respirator and safety goggles. If acid comes in contact with worker's skin or clothing, rinse with plenty of water.

PERFORMANCE GUIDE: (cont.)

CAUTION: Do not treat more than 10 kg (22 pounds) at any one time to avoid uncontrollable heating.

3. Stir seed gently at intervals during treatment in order to obtain uniform results.
   NOTE: If you do not stir frequently, the seed will stick together in clumps and will be difficult to separate.
   CAUTION: Avoid vigorous agitation which may result in injury to seed due to an increase in temperature.
4. Check seed periodically to ascertain thickness of seed coats.
   NOTE: Length of time in which seed are soaked in sulfuric acid varies greatly between species. Check reference manual to determine recommended time for particular plant species.
5. Remove seed from sulfuric acid when seed coat is paper thin.
   CAUTION: The scarification process must end before the seed are injured. Remove seed from sulfuric acid before seed coat is completely disintegrated.
6. Wash off any acid adhering to the seed by rinsing seed in running water for 10 minutes.
7. Repeat above steps with remainder of unscarified seed lot.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Scarify seeds.

ENABLER

1. Look up scarification recommendations.
2. Measure temperature.
3. Recall general equipment and hand tool safety.
4. Recall horticultural chemical safety.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to scarify seeds.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Listed the recommended method of scarification to use on particular species.		
Mechanical scarification:		
2. Placed test lot of dry seed in a mechanical scarifier.		
3. Scratched seed until hard seed coat was removed.		
4. Checked scarified seed.		
5. Adjusted scarification time as needed.		
Hot water scarification:		
6. Heated water to a temperature of 77°-100° C (170°-212° F).		
7. Used a ratio of 4-5 parts water to one part seed.		
8. Dropped seed into hot water.		
9. Removed water/seed mixture from heat source immediately.		

	PERFORMANCE DETERMINANTS (cont.)	**YES**	**NO**
10.	Allowed water to cool gradually.		
11.	Soaked seed for 12-24 hours.		
12.	Separated swollen seed from unswollen seed.		
13.	Retreated seed that had not swelled.		
Acid scarification:			
14.	Placed test lot of dry seed in glass, earthenware, or wooden container.		
15.	Covered seed with concentrated sulfuric acid at a ratio of 2 parts acid to 1 part seed.		
16.	Added the sulfuric acid to water instead of adding water to the sulfuric acid.		
17.	Worn protective clothing, respirator and safety goggles.		
18.	Stirred seed gently.		
19.	Checked seed periodically.		
20.	Removed seed from sulfuric acid when seed coat was paper thin.		
21.	Washed off any acid adhering to the seed.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 47

TASK: Prick off seedlings.

STANDARD OF PERFORMANCE OF TASK:

The seedlings must be removed from the flat/raised bed when first or second pair of true leaves have developed. Seedlings must be handled by their leaves and transferred to a prepared hole in medium without harming the hypocotyl (stem). The seedlings must not be allowed to dry out during this procedure.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.
America's Garden Book.

CONDITIONS FOR PERFORMANCE OF TASK:

Label
Seedlings
Pasteurized media
Disinfested dibble
Disinfested container/flat

ENABLING OBJECTIVE:

1. Recognize seedlings that are at the proper stage for pricking off.
2. Label seedlings.
3. Mist seedlings and provide proper growing conditions for newly pricked off seedlings.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.

***RESOURCES: (cont.)**

3. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
4. Checklist - Pricking off seedlings.

TEACHING ACTIVITIES:

1. Show examples of seedlings, containers and medium.
2. Present lecture on characteristics of seedlings. (* 1,2 & 3)
3. Demonstrate how to fill a container.
4. Demonstrate how to a dibble to make a transplant hole.
5. Monitor students as they practice filling containers and using a dibble.
6. Question students on the importance of handling seedlings carefully.
7. Demonstrate how to handle a seedling.
8. Demonstrate how to remove of a clump of seedlings from the flat and how to remove medium from the roots.
9. Demonstrate how to remove a seedling from a clump of seedlings.
10. Demonstrate how to place a seedling in the transplant hole and how to firm of the medium around the seedling.
11. Monitor students as they practice pricking off seedlings.
12. Discuss the importance of accurate labels.
13. Demonstrate how to mist the seedlings and provide other environmental needs of the newly transplanted seedlings.
14. Assign each student a row of seedlings to prick off. (* 4)

CRITERION-REFERENCED MEASURE:

The student must fill a container with medium, make a transplant hole in the medium, place a seedling in the hole, firm the medium around the seedling and mist the seedling. The transplanted seedlings must become established when placed in favorable environmental conditions (less than 5% of the seedlings fail).

PERFORMANCE GUIDE:

1. Check seedlings for pricking off stage, from the cotyledon stage until one pair of leaves is fully developed, to be pricked off.
   CAUTION: After seedlings have developed one pair of leaves, do not delay pricking off the seedlings. A delay will cause seedlings to become spindly.
2. Fill flat/container with moistened medium.
3. Make a hole with a dibble, label, or your finger in the medium large enough to receive the roots of the seedling.
4. Lift small number of seedlings from propagating flat using the end of a small label.
5. Shake medium away from roots gently.
6. Grasp seedlings' leaves using thumb and forefinger to separate an individual seedling away from a clump of seedlings.
   CAUTION: Do not handle seedlings by their stem.
7. Lift seedlings by their leaves and place roots into prepared hole in medium.
8. Press medium around the seedlings' roots.
9. Label each flat/container with the cultivar, species, planting date, and date seedlings were pricked off.
10. Water seedlings with a fine mist immediately after seedlings have been pricked off.
    CAUTION: After seedlings have been pricked off, they are in shock. Provide seedlings with ideal growing conditions for particular species and plenty of moisture during this time.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Prick off seedlings.

ENABLER

1. Label seedlings.
2. Mist seedlings and provide proper growing conditions for newly pricked off seedlings.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prick off seedlings.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Checked moisture content of medium.		
2.	Filled container to correct level.		
3.	Made transplant hole in medium the appropriate size.		
4.	Lifted an appropriate number of seedlings from the propagating flat.		
5.	Avoided damage to seedling roots while lifting seedlings from the propagating flat.		
6.	Handled seedlings by leaves or root clumps.		
7.	Shook medium away from the seedling roots gently.		
8.	Left medium on the roots.		
9.	Grasped a single seedling by the leaves and separated the seedling from the clump.		
10.	Placed roots of seedling in transplant hole with root tip pointing down.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
11. Positioned seedling in transplant hole at correct depth, in correct orientation and position.	________	________
12. Pressed medium around seedling roots without excessive compaction of the medium.	________	________
13. Labeled transplanted seedlings.	________	________
14. Misted seedlings.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 48

TASK: Harden off seedlings.

STANDARD OF PERFORMANCE OF TASK:

Seedlings must be exposed to cool temperatures, high light intensities and reduced irrigation as specified by particular species guidelines until seedlings develop stocky, sturdy growth.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.
Ball Red Book Greenhouse Growing.

CONDITIONS FOR PERFORMANCE OF TASK:

Established seedlings

ENABLING OBJECTIVES:

1. Identify established seedlings.
2. Identify cultural requirements of a particular plant species.
3. Measure temperature.
4. Measure light intensity.
5. Water seedlings.
6. Fertilize seedlings.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers & Publishers, Inc.
5. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
6. Checklist - Hardening off seedlings.

TEACHING ACTIVITIES:

1. Discuss the importance of hardening off seedlings.
2. Show several examples of seedlings that are hardened off and seedlings that are not hardened off.
3. Present lecture on the characteristics of a hardened off seedling. (* 1,2,3,4 & 5)
4. Outline the procedures used to harden off seedlings.
5. Present lecture on the relationship between a plant species low temperature tolerance and the temperature during hardening off.
6. Present lecture on the relationship between a plant species requirement for light intensity and the light intensity during hardening off.
7. Present lecture on the relationship between a plant species drought tolerance and the moisture content of the medium during hardening off.
8. Present lecture on the relationship between a plant species fertilizer requirements and the rate of fertilization during hardening off.
9. Demonstrate how to regulate the temperature.
10. Demonstrate how to regulate the light intensity.
11. Show several examples of seedlings with optimum moisture content in the medium.
12. Assign each student several seedlings to harden off. (* 6)

CRITERION-REFERENCED MEASURE:

The student must identify the growing temperatures and light intensities optimum for hardening off the plant species, move the seedlings to a location where the optimum hardening off environment can be maintained and regulate the hardening off environment, and regulate the moisture content and the fertilizer content of the medium until the seedlings are hardened off. The seedlings should exhibit stocky, sturdy growth without sunburned or wilted leaves.

PERFORMANCE GUIDE:

1. Move flats/containers of established seedlings to a location where a lower growing temperature can be maintained, as specified by particular plant species.

PERFORMANCE GUIDE: (cont.)

2. Increase the intensity of the light to which the seedlings are exposed, if practical.
   NOTE: Light intensity should be increased gradually to prevent the plant from becoming sunburned
3. Reduce irrigation to point where surface of medium is allowed to dry while the medium underneath the surface remains moist.
4. Reduce but do not eliminate fertilizer.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Harden off seedlings.

ENABLER

1. Measure temperature.
2. Measure light intensity.
3. Water seedlings.
4. Fertilize seedlings.

STUDENT'S NAME__________________________ **DATE**__________

EVALUATOR'S NAME__________________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to harden off seedlings.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Listed temperature for hardening off.		
2.	Listed light intensity for hardening off.		
3.	Moved seedlings to location where optimum hardening off environment can be maintained.		
4.	Regulated temperature in hardening off environment.		
5.	Regulated light intensity in hardening off environment.		
6.	Maintained the medium moisture content at level optimum for hardening off.		
7.	Maintained the medium fertilizer content at level optimum for hardening off.		
8.	Avoided sunburn on the seedling leaves.		
9.	Avoided writing of the seedling leaves.		
10.	Recognized seedlings that were hardened off.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 49

TASK: Transplant seedlings.

STANDARD OF PERFORMANCE OF TASK:

Hardened off seedlings must be planted at the recommended depth and firmed around the seedlings. The seedlings must be free from damage and not allowed to dry out.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Disinfested hoe
Disinfested pots
Starter solution
Pasteurized media
Disinfested trowel
Hardened off seedlings

ENABLING OBJECTIVES:

1. Water seedlings.
2. Fertilize seedlings.
3. Evaluate moisture content of medium.
4. Display manual dexterity (the motor skills).

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
5. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.

***RESOURCES:** (cont.)

6. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
7. Sunset Books. (1976). Greenhouse gardening. Menlo Park, CA: Lane Publishing Co.
8. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
9. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
10. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
11. Mechanical transplanter operation instructions.
12. Checklist - Transplanting seedlings.

TEACHING ACTIVITIES:

1. Outline procedures used to transplant seedlings. (* 1,2,3,4,5,6,7,8,9 & 10)
2. Present lecture on mechanical transplanters. (* 5,8,9,10 & 11)
3. Show examples of seedlings that are ready for transplanting and seedlings that are not ready for transplanting.
4. Present lecture on selection of container size and/or field or bed spacing.
5. Demonstrate how to remove a seedling from its container.
6. Demonstrate how to handle a seedling.
7. Show examples of long scraggly roots.
8. Present lecture on why/when long scraggly roots should be pruned. (* 1,2,3,4,5,6,7,8,9 & 10)
9. Demonstrate how to prune the roots.
10. Discuss the importance of using moistened medium.
11. Demonstrate how to fill a container and place the seedling into the container.
12. Discuss the importance of transplanting seedlings at the correct depth.
13. Discuss the importance of avoiding compaction of the medium.
14. List plants that are transplanted deeper/shallower than the original seedling depth.
15. Demonstrate how to transplant to a prepared field or bed.
16. Discuss the importance of a prepared soil, moist soil and proper planting depth.
17. Assign students to water and fertilize the transplanted seedlings.
18. Assign each student a block of hardened off seedlings to transplant. (* 12)

CRITERION-REFERENCED MEASURE:

The student must separate the seedlings that are ready for transplanting, water the seedlings, prune the roots as needed, place the seedling into its new location, water and fertilize as needed. The transplanted seedlings must be visibly undamaged, must not be allowed to wilt, and produce growth that is comparable to seedlings transplanted at the same time by the test administrator.

PERFORMANCE GUIDE:

1. Check root systems of hardened off seedlings to determine if seedlings are ready for transplanting.
   NOTE: Seedlings must be transplanted when roots fill the growing container in order to prevent check in plant growth.
2. Water seedlings thoroughly.
3. Remove seedling from container.
   CAUTION: Long, scraggly roots, need to be pruned. With woody plants, one to four vertical cuts should be made through the seedlings' root ball at a depth of 1/2 - 1 inch. The slick surface of the soilball should be disturbed.
4. Identify new location of transplant:
   A. Transplanting into larger pot:
      1. Select a pot larger than the one the seedling has been growing in.
      2. Fill pot 2/3 full with a moistened medium.
      3. Place seedling in the center of the pot.
      4. Add additional medium to cover roots of seedling.
         CAUTION: Seedlings should be planted at the same depth they were previously grown, or slightly deeper.
      5. Firm medium around seedling.

   B. Transplanting to permanent location:
      1. Make furrow or hole in prepared growing area.
      2. Place seedlings at optimum spacing for species.
         CAUTION: Seedlings should be planted at the same depth they were previously grown, or for many species slightly deeper.
      3. Cover roots of seedling with soil.
      4. Firm soil around seedling.

PERFORMANCE GUIDE: (cont.)

5. Water transplants thoroughly.
6. Fertilize transplants with a starter solution.
7. Check the medium's moisture content frequently until transplants are established.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Transplant seedlings.

ENABLER

1. Water seedlings.
2. Fertilize seedlings.
3. Evaluate moisture content of medium.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to transplant seedlings.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Checked root system of hardened off seedlings.	______	______
2.	Watered seedlings.	______	______
3.	Removed seedling from container.	______	______
4.	Pruned roots of seedlings.	______	______
Transplanting into larger pot:			
5.	Selected a pot larger than the pot in which the seedling had been growing in.	______	______
6.	Filled pot 2/3 full with a moistened medium.	______	______
7.	Placed seedling in the center of the pot.	______	______
8.	Added additional medium to cover roots of seedling.	______	______
9.	Planted seedlings at the same depth they were previously grown, or slightly deeper.	______	______
10.	Firmed medium around seedling.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Transplanting to permanent location:		
11. Made furrow or hole in prepared growing area.	______	______
12. Placed seedlings at optimum spacing for species.	______	______
13. Covered roots of seedling with soil.	______	______
14. Firmed soil around seedling.	______	______
15. Planted seedlings at the same depth they were previously grown or slightly deeper.	______	______
16. Watered transplants thoroughly.	______	______
17. Fertilized transplants with a starter solution.	______	______
18. Checked the medium's moisture content frequently until transplants were established.	______	______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 50

TASK: Take cuttings.

STANDARD OF PERFORMANCE OF TASK:

The cuttings must be taken from healthy stock plants and good sanitation practices must be observed. Cuttings must be free from damage and equal the recommended length for particular plant species. The cuttings must be kept moist until they are stuck in the propagating medium.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Spade
Band saw
Container
Pruning shears
Disinfested knife

ENABLING OBJECTIVES:

1. Look up propagation method.
2. Recall external parts of a plant stem.
3. Determine age of plant stem.
4. Recognize healthy, disease free plants.
5. Distinguish deciduous from evergreen plants.
6. Distinguish woody plants from herbaceous plants.
7. Measure or estimate distance (inches).

***RESOURCES:**

1. Symonds, G. (1963). The shrub identification book. Fort Atkinson, WI: Nasco.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Taking cuttings.

TEACHING ACTIVITIES:

1. List types of cuttings. (* 1,2 & 3)
2. List plants propagated by the listed types of cuttings. (* 1,2,3 & 4)
3. List references available to help determine the method of propagation best suited for a particular plant. (* 1,2,3 & 4)
4. Assign student to look up the recommended propagation method(s) for a plant.
5. Present lecture on disinfestation of tools. (* 1,2 & 3)
6. Discuss the importance of avoiding taking cuttings from diseased or otherwise weakened plants.
7. Present lecture on taking stem cuttings. (* 1,2 & 3)
8. Demonstrate how to take hardwood stem cuttings.
9. Demonstrate how to take semihardwood stem cuttings.
10. Demonstrate how to take soft wood stem cuttings.
11. Demonstrate how to take herbaceous stem cuttings.
12. Discuss the importance of handling or marking stem cuttings to indicate the polarity of the stem on the stock plant.
13. Present lecture on leaf cuttings. (* 1,2 & 3)
14. Demonstrate how to take leaf cuttings.
15. Demonstrate how to take leaf-bud cuttings.
16. Present lecture on root cuttings. (* 1,2 & 3)
17. Demonstrate how to take root cuttings.
18. Show examples of containers used to keep cuttings moist.
19. Discuss the importance of avoiding diseased plants and disinfestation of tools.
20. Monitor students as they practice taking cuttings.
21. Assign each student a stock plant(s) from which to take cuttings. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select healthy, disease free stock plants and take the cuttings according to the recommended procedures for the assigned type of cutting(s). Good sanitation practices must be

CRITERION-REFERENCED MEASURE: (cont.)

observed, cuttings must be free from damage and equal the recommended length for particular plant species, and kept moist.

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by cuttings.
2. Select healthy, disease free stock plants.
3. Identify specific plant part needed for the propagation of particular plant species:
    A. Stem cuttings:
        1. Identify type of wood needed for cutting:
            a. Hardwood stem cutting:
                1. Select stock plants with dormant hardwood.
                   NOTE: Generally, deciduous hardwood and narrow-leaved evergreen stem cuttings are taken at the base of the current year's growth from wood of moderate size.
                2. Identify type of hardwood cutting best suited for particular plant species:
                    a. Straight stem cutting.
                    b. Heel cutting.
                    c. Mallet cutting.
                3. Schedule the preparation of deciduous hardwood stem cuttings for late fall or early spring and narrow-leaved evergreen hardwood stem cuttings for fall or through late winter.
                4. Remove cutting from stock plant:
                    a. Select proper region on deciduous plant to remove cutting:
                        1. Discard tip portion of all plant shoots.
                        2. Include at least two nodes in the cutting.
                        3. Cut stem and remove cutting at desired location from stock plant for particular plant species.

PERFORMANCE GUIDE: (cont.)

        b. Select proper region on narrow-leaved evergreens to remove cutting:
            1. Cut stem and remove cutting at desired location from stock plant for particular plant species.
            2. Remove leaves from lower 1/4-1/3 of cutting.
            3. Discard tip portion when appropriate.
b. Semihardwood cuttings:
    1. Select stock plants with semihardwood:
        a. Schedule the preparation of woody, broad-leaved evergreen cuttings after stock plant has a flush of new growth.
        b. Schedule the preparation of deciduous cuttings after stock plant has a flush of new growth.
    2. Cut stem and remove a 3-6 inch stem cutting from the partially matured wood of the plant.
       NOTE: At least two nodes must be included in cutting.
    3. Remove leaves from lower 1/4-1/3 of cutting.
    4. Trim the size of any remaining large leaves.
c. Softwood cuttings:
    1. Select deciduous or evergreen stock plants with soft, succulent, new spring growth.
    2. Cut and remove a 3-6 inch stem cutting from current year's growth which has hardened off.
       NOTE: At least two nodes must be included in the cutting, unless single node cuttings are recommended
       NOTE: Cuttings should not be taken from the extremely soft growth or the older woody stems.

PERFORMANCE GUIDE: (cont.)

            3. Remove leaves from lower 1/4-1/3 of cutting.
        d. Herbaceous cuttings:
            1. Select herbaceous stock plants.
            2. Include at least two nodes per cutting.
            3. Cut and remove a 3-5 inch stem cutting from plant.
            4. Remove leaves from lower 1/4 - 1/3 of cutting.

B. Leaf cuttings:
    1. Identify type of leaf cutting best suited for particular plant species:
        a. Leaf blade cutting.
        b. Leaf blade with petiole cutting.
    2. Remove leaf cutting from stock plant:
        a. Remove entire leaf blade from stock plant when taking a leaf blade cutting:
            1. Cut leaf blade into sections to produce additional cuttings, if possible for particular plant species.
            2. Reduce leaf size by trimming leaf, if necessary for particular plant species.
        b. Remove entire leaf blade and petiole from stock plant when taking a leaf blade with petiole cutting:
            1. Reduce leaf size by trimming leaf, if necessary for particular plant species.
            2. Trim petiole to approximately 1/2-1 inch length, depending upon particular plant species.

C. Leaf-bud cuttings:
    1. Remove leaf-bud cutting from the stock plant:
        a. Include a leaf blade, petiole, axillary bud, and a short piece of stem on each cutting.
        b. Divide the stem piece in half vertically on plant species with an opposite bud arrangement to produce two leaf-bud cuttings with each containing a leaf blade, petiole, axillary bud, and a short stem piece.

PERFORMANCE GUIDE: (cont.)

- D. Root cuttings:
  - 1. Select young stock plants.
  - 2. Remove cuttings from stock plants when stock plants are dormant:
    - a. Cut and remove root cuttings from stock plants:
      - 1. Trim root cuttings from plants with small delicate roots to 1-2 inches long.
      - 2. Trim root cuttings from plants with somewhat fleshy roots to 2-3 inches long.
      - 3. Trim root cuttings from plants with large roots to 2-6 inches.
    - b. Mark ends of cuttings so correct polarity can be maintained when sticking cuttings.
- 4. Disinfest knife and other propagating tools frequently to prevent the spread of disease.
- 5. Keep cuttings moist until they are stuck in propagating medium.
- 6. Label stored cuttings.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Take cuttings.

ENABLER

1. Look up propagation method.
2. Recall external parts of a plant stem.
3. Determine age of plant stem.
4. Recognize healthy, disease free plants.
5. Distinguish deciduous from evergreen plants.
6. Distinguish woody plants from herbaceous plants.
7. Measure or estimate distance (inches).

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to take cuttings.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Selected healthy, disease free stock plants.	_____	_____
	Hardwood stem cuttings:		
2.	Selected stock plants with dormant hardwood.	_____	_____
3.	Selected proper region on deciduous plant to remove cutting.	_____	_____
4.	Discarded tip portion of all plant shoots.	_____	_____
5.	Included at least two nodes in the cutting.	_____	_____
6.	Selected region on narrow-leaved evergreens to remove cutting.	_____	_____
7.	Cut stem and removed cutting at desired location from stock plant for particular plant species.	_____	_____
8.	Discarded top portion of cutting.	_____	_____

PERFORMANCE DETERMINANTS (cont.)	YES	NO
9. Removed leaves from lower 1/4-1/3 of cutting if needed.	________	________
Semihardwood cuttings:		
10. Selected stock plants with semihardened growth.	________	________
11. Cut stem and removed a 3-6 inch stem cutting from the partially matured wood of the plant.	________	________
12. Included at least two nodes in cutting.	________	________
13. Removed leaves from lower 1/4-1/3 of cutting if needed.	________	________
14. Trimmed the size of any remaining large leaves if needed.	________	________
Softwood cuttings:		
15. Selected deciduous or evergreen stock plants with soft, succulent, new spring growth.	________	________
16. Cut and removed a 3-6 inch stem cutting from current year's growth which has hardened off.	________	________
17. Included at least two nodes in the cutting. (except when single node cutting are recommended)	________	________
18. Selected cuttings from areas other than the extremely soft growth or the older woody stems.	________	________
19. Trimmed the size of any remaining large leaves if needed.	________	________
20. Removed leaves from lower 1/4-1/3 of cutting if needed.	________	________
21. Discarded top of cutting when appropriate.	________	________

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Herbaceous cuttings:		
22. Selected herbaceous stock plants.	______	______
23. Included at least two nodes per cutting.	______	______
24. Cut and removed a 3-5 inch stem cutting from the plant.	______	______
25. Removed leaves from lower 1/4-1/3 of the cutting if needed.	______	______
26. Trimmed the size of any remaining leaves if needed.	______	______
Leaf cuttings:		
27. Removed entire leaf blade from stock plant.	______	______
28. Cut leaf blade into sections to produce additional cuttings.	______	______
29. Reduced leaf size by trimming leaf if needed.	______	______
Leaf-bud cuttings:		
30. Included a leaf blade, petiole, axillary bud, and a short piece of stem on each cutting.	______	______
31. Divided the stem piece in half vertically on plant species with an opposite bud arrangement.	______	______
Root cuttings:		
32. Selected young stock plants.	______	______
33. Removed cuttings from stock plants when stock plants were dormant.	______	______
34. Trimmed root cuttings from plants with small delicate roots to 1-2 inches long.	______	______

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
35.	Trimmed root cuttings from plants with somewhat fleshy roots to 2-3 inches long.		
36.	Trimmed root cuttings from plants with large roots to 2-6 inches.		
37.	Marked ends of cuttings.		
38.	Disinfested knife and other propagating tools frequently to prevent the spread of disease.		
39.	Kept cuttings moist until they were stuck in propagating medium.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 51

TASK: Stick cuttings in medium other than water or mist.

STANDARD OF PERFORMANCE OF TASK:

Prepared cuttings must be stuck uniformly into hole/furrow in rooting medium at a depth that will support the cuttings. Cuttings must be stuck at optimal spacing for species.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Disinfestant
Disinfested knife
Disinfested dibble
Prepared cuttings
Pasteurized rooting medium

ENABLING OBJECTIVES:

1. Look up recommended propagation method.
2. Disinfest tools.
3. Label cuttings.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Sticking cuttings.

TEACHING ACTIVITIES:

1. List plants that are propagated by cuttings. (* 1,2,3 & 4)
2. Present lecture on reasons why the listed plants are propagated by cuttings. (* 1,2,3 & 4)
3. List resources available to help determine the recommended spacing for the cuttings. (* 1,2,3 & 4)
4. Assign students to look up the recommended spacing for the listed plants.
5. Present lecture on the requirements of the rooting medium. (* 1,2 & 3)
6. Present lecture on controlling the relative humidity around the cuttings after they have been stuck. (* 1,2 & 3)
7. Discuss the importance of sanitation. (* 1,2 & 3)
8. Show examples of prepared cuttings.
9. Demonstrate how to handle the prepared cuttings.
10. Discuss the importance of protecting the prepared cutting from drying. (* 1,2 & 3)
11. Demonstrate how to make a furrow or holes in the rooting medium.
12. Present lecture on depth at which to stick cuttings. (* 1,2,3 & 4)
13. Question students on how to determine which end of the cutting is the top.
14. Demonstrate how to place prepared cuttings into the furrow or hole.
15. Demonstrate how to firm the medium around the cuttings.
16. Assign students to label the cuttings.
17. Monitor students as they practice sticking cuttings.
18. Assign each student a bundle of prepared cuttings to stick. (* 5)

CRITERION-REFERENCED MEASURE:

The student must determine and list the recommended spacing for the cuttings, disinfest the tools and cuttings, place the cutting into a furrow or hole, firm the medium around the cutting, and label the cuttings. The listed spacing must be the same as is recommended in the resource material, the cuttings must be stuck uniformly without drying, and the success rate of the cuttings must be the same (plus or minus 10%) as similar cuttings stuck by the test administrator.

PERFORMANCE GUIDE:

1. Water the pasteurized rooting medium thoroughly.
2. Identify optimal spacing for particular species and type of cutting.
3. Make furrow with knife or make holes with a dibble in rooting medium.
   CAUTION: Strict sanitation must be maintained in propagation area to prevent the spread of disease. Tools must be disinfested frequently.
4. Disinfest the prepared cutting.
5. Insert prepared cutting only to a depth that will support the cutting.
   CAUTION: Do not allow cuttings to dry out during the insertion process.
   CAUTION: Shallow insertion provides better aeration for the cutting.
   CAUTION: Cuttings must be inserted into the medium right side up.
6. Firm rooting medium around cutting.
7. Label each species/variety of cuttings that has been stuck.
8. Provide optimal relative humidity for particular plant species immediately after the cuttings are stuck.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Stick cuttings in medium other than water or mist.

ENABLER

1. Look up recommended propagation method.
2. Disinfest tools.
3. Label cuttings.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to stick cuttings.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Listed the optimal spacing for particular species and type of cutting.	______	______
2.	Made furrow or holes in rooting medium.	______	______
3.	Disinfested tools frequently.	______	______
4.	Disinfested the prepared cutting.	______	______
5.	Inserted prepared cutting only to a depth that would support the cutting.	______	______
6.	Did not allow cuttings to dry out during the insertion process.	______	______
7.	Cuttings were inserted into the medium right side up.	______	______
8.	Firmed rooting medium around cutting.	______	______
9.	Labeled cuttings.	______	______
10.	Provided optimum relative humidity for particular plant species.	______	______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 52

TASK: Apply growth regulator to cuttings.

STANDARD OF PERFORMANCE OF TASK:

Growth regulators (rooting compounds) must be applied uniformly to the freshly cut end of the cutting at the recommended level for particular plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Prepared cuttings
Disinfested container
Disinfested knife
Growth regulator (rooting compound)

ENABLING OBJECTIVES:

1. Read growth regulator label.
2. Recall horticultural chemical safety.
3. Measure growth regulator and mix growth regulator solution.
4. Measure time (seconds/minutes/hours).
5. Measure temperature of growth regulator solution.

***RESOURCES:**

1. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.

***RESOURCES:** (cont.)

5. Growth regulator label.
6. Checklist - Applying growth regulator to cuttings.

TEACHING ACTIVITIES:

1. Present lecture on the purpose of using growth regulators. (* 1,2 & 3)
2. List growth regulators used as rooting compounds.
3. Present lecture on methods of applying growth regulators. (* 1,2 & 3)
4. List plants for which the use of rooting compounds is recommended. (* 1,2,3 & 4)
5. List resources available to determine the growth regulator treatment for a particular plant. (* 1,2,3 & 4)
6. Present lecture on specific growth regulator(s) and the application method(s) recommended for the listed plants. (* 1,2,3 & 4)
7. Present lecture on how to avoid the spread of diseases when applying growth regulators. (* 1,2 & 3)
8. Demonstrate how to prepare cuttings prior to the application of the growth regulator. (* 1,2 & 3)
9. Demonstrate how to apply commercial powder preparations. (* 5)
10. Show examples of cutting with too much and too little growth regulator powder.
11. Question students on measurement and mixing procedures.
12. Assign students to mix a growth regulator solution.
13. Demonstrate how to apply growth regulators by dipping and/or soaking. (* 1,2 & 3)
14. Present lecture on temperature requirements for soaking cuttings in growth regulator solutions. (* 1,2 & 3)
15. Present lecture on disposal of used growth regulator solution or powder according to label instructions.
16. Assign each student a bundle or bag of cuttings to which to apply growth regulator. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the recommend growth regulator treatment make a fresh cut at the base of the cutting and apply the growth regulator. The listed treatment must be the same as the treatment recommended in the resources growth regulator must

CRITERION-REFERENCED MEASURE: (cont.)

be uniformly applied (powdered growth regulator visually uniform) dipped or soaked cuttings must remain in the growth regulator solution for the listed time and sanitation practices must be followed.

PERFORMANCE GUIDE:

1. Select plant species that respond favorably to growth regulator (rooting compound).
2. Obtain prepared cutting.
3. Select growth regulator, generally an auxin, to promote rooting on particular species.
4. Identify optimal method of applying growth regulator:
   CAUTION: Disease organisms can be spread by the growth regulator.
   - A. Applying commercial powder preparation:
     1. Place a small amount of growth regulator powder into a disinfested container.
     2. Make a fresh cut with disinfested knife at the base of individual or bundle of cuttings.
     3. Dip base of cuttings into growth regulator.
     4. Tap excess growth regulator from cuttings.
        NOTE: A small amount of growth regulator powder should adhere to the base of the cutting.
     5. Obtain another disinfested container with a fresh amount of growth regulator frequently.
     6. Discard any used growth regulator powder according to label instructions.
   - B. Dipping in concentrated solution:
     1. Pour a small amount of concentrated solution into a disinfested container.
        CAUTION: Follow instructions on growth regulator label when mixing concentrated solution.
     2. Dip basal end, lower one inch, of bundle of cuttings into concentrated solution of growth regulator for approximately 5 seconds.
     3. Obtain another disinfested container with concentrated solution periodically, during treatment process.
     4. Discard any used growth regulator solution, after treatment according to label instructions.

PERFORMANCE GUIDE: (cont.)

C. Soaking in dilute solution:
1. Pour a small amount of dilute solution of growth regulator in a disinfested container.
   CAUTION: Follow instructions on growth regulator label, when mixing dilute solution.
2. Soak basal portion, lower 1 inch, of cutting in a dilute solution of growth regulator for 24 hours.
3. Maintain a temperature of 20° C (68° F), during this period.
4. Shade plants from the sun.
5. Discard any used growth regulator solution, after treatment according to label instructions.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Apply growth regulator to cuttings.

ENABLER

1. Read growth regulator label.
2. Recall horticultural chemical safety.
3. Measure regulator and mix growth regulator solution.
4. Measure time (seconds/minutes/hours).
5. Measure temperature of growth regulator solution.

STUDENT'S NAME________________________**DATE**__________

EVALUATOR'S NAME______________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to apply growth regulator to cuttings.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected growth regulator.	______	______
	Applying commercial powder preparation:		
2.	Placed a small amount of growth regulator powder into a disinfested container.	______	______
3.	Made a fresh cut with a disinfested knife at the base of individual or bundle of cuttings.	______	______
4.	Dipped base of cuttings into growth regulator.	______	______
5.	Tapped excess growth regulator from cuttings.	______	______
6.	A small amount of growth regulator powder adhered to the base of cutting.	______	______
7.	Obtained a disinfested container with a fresh amount of growth regulator as needed.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Dipping in concentrated solution:		
8. Discarded any used growth regulator powder according to label instructions.	________	________
9. Poured a small amount of concentrated solution into a disinfested container.	________	________
10. Followed instructions on growth regulator label when mixing concentrated solution.	________	________
11. Dipped basal end, lower one inch, of bundle of cuttings into concentrated solution of growth regulator for approximately 5 seconds.	________	________
12. Obtained a disinfested container with concentrated solution as needed.	________	________
13. Discarded any used growth regulator solution according to label instructions.	________	________
Soaking in dilute solution:		
14. Poured a small amount of dilute solution of growth regulator in a disinfested container.	________	________
15. Followed instructions on growth regulator label, when mixing dilute solution.	________	________
16. Soaked basal portion, lower 1 inch, of cutting in a dilute solution of growth regulator for 24 hours.	________	________
17. Maintained a temperature of 20° C (68° F) when soaking cuttings.	________	________
18. Protected plants from the sun.	________	________
19. Discarded any used growth regulator solution according to label instructions.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 53

TASK: Remove cuttings from the propagating area.

STANDARD OF PERFORMANCE OF TASK:

Rooted cuttings must be removed from propagating area with minimal damage to root system.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Burlap
Spade/trowel
Propagation bed
Mechanical digger
Pasteurized media
Rooted cuttings

ENABLING OBJECTIVES:

1. Distinguish hardwood cuttings from softwood and semi-softwood cuttings.
2. Recognize dormant rooted cuttings.
3. Recall how to protect cuttings from drying.

*RESOURCES:

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.

***RESOURCES:** (cont.)

5. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.
6. Mechanical digging equipment operating instructions.
7. Checklist - Removing cuttings from the propagating area.

TEACHING ACTIVITIES:

1. Show examples of cuttings that are well rooted and cutting that are not well rooted.
2. Show examples of rooted cuttings that are and are not hardened off.
3. List resources available to help determine the amount of rooting and/or extent of hardening off required. (* 1,2,3 & 4)
4. Demonstrate how to dig a rooted cutting.
5. Discuss the importance of protecting the roots from drying.
6. Present lecture on mechanical digging equipment. (* 1,2,3 & 6)
7. List possible ways to utilize and/or store rooted cuttings. (* 1,2,3 & 4)
8. Present lecture on the planting requirements (spacing, soil conditions) for rooted cuttings.
9. Demonstrate how to replant the rooted cuttings.
10. Present lecture on packaging of rooted cuttings for cold storage. (* 1,2,3 & 5)
11. Present lecture on requirements of the area used to heel in cuttings (moisture drainage). (* 1,2,3 & 5)
12. Demonstrate how to heel in rooted cuttings.
13. Question students on how to protect the rooted cuttings from drying.
14. Assign each student a block of rooted cuttings to remove from the propagating area. (* 7)

CRITERION-REFERENCED MEASURE:

The student must dig the rooted cutting and replant or store the rooted cuttings. The roots of the cuttings must not be damaged or allowed to dry, and the success rate of the rooted cuttings must be the same (plus or minus 10%) as similar rooted cuttings removed by the test administrator.

PERFORMANCE GUIDE:

1. Check rooted cuttings to verify, that substantial rooting has occurred and rooted cuttings have been hardened off.
2. Dig rooted cuttings with spade, trowel, or mechanical digger with only minimal disturbance to root system.
   NOTE: Rooted hardwood cuttings are usually dug, while plants are dormant.
   CAUTION: Do not allow rooted cuttings to dry out, during digging process.
3. Identify when plants will be utilized:
   A. Replant rooted cuttings at desired location immediately.
   B. Place rooted cuttings in cold storage for temporary storage.
   C. Heel in rooted cuttings for temporary storage.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Remove cuttings from the propagating area.

ENABLER

1. Distinguish hardwood cuttings from softwood and semi-softwood cuttings.
2. Recognize dormant rooted cuttings.
3. Recall how to protect cuttings from drying.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to remove cuttings from the propagating area.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Checked rooted cuttings.		
2.	Dug rooted cuttings with only minimal disturbance to root system.		
3.	Rooted cuttings were not allowed to dry out.		
4.	Replanted rooted cuttings at desired location immediately.		
5.	Placed rooted cuttings in cold storage for temporary storage.		
6.	Heeled in rooted cuttings for temporary storage.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 54

TASK: Harden off cuttings.

STANDARD OF PERFORMANCE OF TASK:

Moisture stress to rooted cutting must be prevented and optimum relative humidity reduced without injury to specified plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Rooted cuttings
Mist/Fog system
Soluble fertilizer

ENABLING OBJECTIVES:

1. Identify the extent of root growth required before the hardening off process should be performed.
2. Set time clock for mist/fog system.
3. Pot cuttings.
4. Recognize signs of moisture stress.
5. Fertilize container grown plants.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers. Fort Worth, TX: Branch-Smith Publishing.

*RESOURCES: (cont.)

5. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
6. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers & Publishers, Inc.
7. Checklist - Hardening off cuttings.

TEACHING ACTIVITIES:

1. Discuss the importance of hardening off rooted cuttings. (* 5 & 6)
2. Outline steps used to harden off rooted cuttings.
3. Show examples of high relative humidity.
4. Show examples of low relative humidity.
5. Question students on how to estimate the relative humidity around a mist bench.
6. Question students on how to reduce the relative humidity around a mist bench.
7. Demonstrate how to check rooted cuttings to determine if substantial rooting has occurred. (* 1,2,3 & 4)
8. Discuss the importance of careful handling of rooted cuttings.
9. Assign students to pot a cutting.
10. Assign students to label the potted cutting.
11. List ways to achieve cool, humidity & shady conditions.
12. Demonstrate how to place potted cuttings in a cool, humid, shaded location.
13. List signs of moisture stress.
14. Demonstrate how to reduce the relative humidity around the potted cuttings.
15. Present lecture on fertilization of potted cuttings.
16. Assign each student a block of rooted cuttings to harden off. (* 7)

CRITERION-REFERENCED MEASURE:

The student must pot the rooted cuttings and reduce the relative humidity around the potted cuttings without causing moisture stress to the potted cuttings. After two weeks the potted cuttings must be able to withstand environmental conditions recommended for the plant species (less than 5% of plants show signs of moisture stress).

PERFORMANCE GUIDE:

1. Check cuttings to determine if substantial rooting has occurred.
2. Reduce relative humidity gradually, until rooted cuttings are conditioned to a drier environment:
   - A. Reduce intervals or duration of misting periods, while rooted cuttings are in mist bed.
   - B. Pot rooted cuttings after rooting is completed and place pots in cool, humid, shaded location.

     CAUTION: Cuttings must be hardened off to prevent defoliation and deterioration of root system.
3. Increase ventilation in propagation area.
4. Check cuttings frequently during hardening off period, approximately 2 weeks, for signs of moisture stress.
5. Apply dilute soluble fertilizer, if needed.
6. Adjust relative humidity as needed.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Harden off cuttings.

ENABLER:

1. Pot rooted cuttings.
2. Recognize signs of moisture stress.
3. Fertilize container grown plants.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use this checklist to evaluate the student's ability to harden off cuttings.

PERFORMANCE DETERMINANTS	YES	NO
1. Removed rooted cuttings from mist bench with minimal damage to roots.	______	______
2. Potted the rooted cuttings.	______	______
3. Labeled potted cuttings.	______	______
4. Watered the potted cuttings.	______	______
5. Placed potted cuttings in a cool, humid, shaded location.	______	______
6. Reduced relative humidity gradually around potted cuttings.	______	______
7. Avoided moisture stress to the potted cuttings.	______	______
8. Fertilized potted cuttings if needed.	______	______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 55

TASK: Propagate plants using approach grafting.

STANDARD OF PERFORMANCE OF TASK:

Plants must be grafted while actively growing. The scion and stock must fit tightly together by matching identical cuts, by matching a tongued cut, or by matching scion into slot on stock plant. Cambial regions must be in close contact with each other. The graft union must be secured and not allowed to dry out. After the graft has healed, the scion must be cut and removed below the union and the stock must be cut and removed above the union.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Practices and Principles.

CONDITIONS FOR PERFORMANCE OF TASK:

Raffia
String
Nails
Hammer
Scion plant
Stock plant
Disinfested knife
Nurseryman's tape
Grafting rubbers
Grafting wax

ENABLING OBJECTIVES:

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.

***RESOURCES:** (cont.)

3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Propagating plants using approach grafting.

TEACHING ACTIVITIES:

1. Outline procedure used to propagate plants using approach. (* 1,2,3 & 4)
2. Present lecture on reasons why approach grafting is performed. (* 1,2,3 & 4)
3. List plants that are propagated using approach grafting. (* 1,2,3 & 4)
4. Present lecture on the stage of growth (actively growing) in which approach grafting is performed. (* 1,2,3, & 4)
5. Present lecture on the preparation of scion wood.
6. Discuss the importance of selecting healthy plants. (* 5,6,7 & 8)
7. Present lecture on graft compatibility between and within families, genera, species, varieties and clones. (* 1,2,3,4,9 & 10)
8. Question students on knife safety.
9. Present lecture on grafting tool disinfestation procedures. (* 1,2,3,4,9 & 10)
10. Show examples of prepared stock and scion.

TEACHING ACTIVITIES: (cont.)

11. Question students on stage of growth during which approach grafting is performed.
12. Demonstrate how to perform a spliced approach graft.
13. Demonstrate how to perform a tongued approach graft.
14. Demonstrate how to perform an inlay approach graft.
15. Discuss the importance of cambial alignment.
16. Demonstrate how to secure the graft union.
17. Demonstrate how to cover the entire graft union with grafting wax.
18. Question students on knife safety.
19. Discuss the importance of grafting tool disinfestation.
20. Monitor students as they practice approach grafting.
21. Assign each student a plant(s) to propagate using approach grafting. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the time of year and/or stage of growth when the grafting should be performed, select healthy, disease-free stock and scion, place the cambial layers in close contact (following approach grafting procedures) and protect the graft union from drying. The graft union must not be allowed to dry out and 50% of the graft unions heal.

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by approach grafting.
2. Select healthy, disease-free, compatible plants.
3. Prepare the stock and scion, when plants are actively growing.
   NOTE: Stock and scion are independent growing plants, until graft union has occurred. One of the plants is generally growing in a container.
4. Identify method of approach grafting to use:
   A. Spliced approach graft:
      1. Select scion and stock of equal diameter.
      2. Make an identical 1-2 inch cut through the bark and slightly into the wood at location where graft union will occur on both scion and stock.
         NOTE: Cuts must be smooth and flat to insure close cambial contact.

PERFORMANCE GUIDE: (cont.)

        3. Match the 2 cut surfaces.
    B. Tongued approached graft:
        1. Follow steps 1 and 2 of the spliced approach graft.
        2. Make a second cut at location where graft union will occur on both the stock and scion:
            a. Cut downward on the stock to form a thin tongue.
            b. Cut upward on the scion to form a thin tongue.
        3. Interlock tongue of scion and stock.
    C. Inlay approach graft:
        1. Select stock plant with thicker bark than scion plant.
        2. Make a narrow slot on stock plant, approximately 3-4 inches in length and the exact width of scion, when the bark is "slipping".
           NOTE: Slot is made by making two parallel cuts and removing bark in between the cuts.
        3. Make a cut at the location of the graft union on the scion:
            a. Cut through bark and slightly into wood.
            b. Make cut the same length as cut on stock plant.
        4. Lay the cut surface of scion into slot on stock plant.
5. Secure the graft union.
6. Cover entire graft union with grafting wax.
7. Cut and remove the stock above the union, after the graft has healed.
8. Cut and remove the scion below the union, after the graft has healed.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using approach grafting.

ENABLER

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using approach grafting.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Selected healthy, disease-free, compatible plants.	______	______
2. Prepared the stock and scion:		
Spliced approach graft:		
3. Selected scion and stock of equal diameter.	______	______
4. Made an identical 1-2 inch cut through the bark and slightly into the wood at graft union location.	______	______
Tongued approached graft:		
5. Selected scion and stock of equal diameter.	______	______
6. Made an identical 1-2 inch cut through the bark and slightly into the wood at location where graft union will occur on both scion and stock.	______	______
7. Matched the 2 cut surfaces.	______	______
8. Followed steps 3 and 4 of the spliced approach graft.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
9. Made a second cut at location where graft union will occur on both the stock and scion.	________	________
10. Interlocked tongue of scion and stock.	________	________
Inlay approach graft:		
11. Selected stock plant with thicker bark than scion plant.	________	________
12. Made a narrow slot on stock plant, approximately 3-4 inches in length and the exact width of scion.	________	________
13. Made a cut at the location of the graft union on the scion.	________	________
14. Laid the cut surface of scion into slot on stock plant.	________	________
15. Secured the graft union.	________	________
16. Covered entire graft union with grafting wax.	________	________
17. Cut and removed the stock above the union.	________	________
18. Cut and removed the scion below the union.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 56

TASK: Propagate plants using bark grafting.

STANDARD OF PERFORMANCE OF TASK:

The scion must be inserted under bark on stock so cambial regions of stock and scion are in close contact with each other. The graft union must be secured and together with the stub, covered with grafting wax.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Nails
Waxed cloth
Scionwood
Rootstock
Adhesive tape
Wrapping string
Sharp grafting knife

ENABLING OBJECTIVES:

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

*RESOURCES: (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Propagating plants using bark grafting.

TEACHING ACTIVITIES:

1. Outline procedure used to propagate plants using bark grafting. (* 1,2,3 & 4)
2. Present lecture on reasons why bark grafting is performed. (* 1,2,3 & 4)
3. List plants that are propagated using bark grafting. (* 1,2,3,4 & 5)
4. Present lecture on the time of year (dormant) in which the scion wood is collected. (* 1,2,3 & 4)
5. Present lecture on the preparation of scion wood. (* 1,2,3 & 4)
6. Show examples of scion wood that has been stored.
7. Discuss the importance of selecting healthy plants. (* 6,7 & 8)
8. Present lecture on graft compatibility between and within families, genera, species, varieties and clones. (* 1,2,3,4,9 & 10)
9. Question students on knife safety.
10. Present lecture on grafting tool disinfestation procedures. (* 1,2,3,4,9 & 10)
11. Show examples of prepared stock and scion.
12. Question students on time of year during which bark grafting is performed.
13. Demonstrate how to prepare the scion.
14. Demonstrate how to prepare the stock.
15. Demonstrate how to put the stock and scion together.
16. Discuss the importance of cambial alignment.

TEACHING ACTIVITIES: (cont.)

17. Demonstrate how to secure the graft union.
18. Demonstrate how to cover the entire graft union with grafting wax.
19. Question students on knife safety.
20. Discuss the importance of grafting tool disinfestation.
21. Monitor students as they practice bark grafting.
22. Assign each student a plant(s) to propagate using bark grafting. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the time of year and/or stage of growth when grafting should be performed, select healthy, disease-free stock and scion, place the cambial layers in close contact (following bark grafting procedures) and protect the graft union from drying. The graft union must not be allowed to dry out and 50% of the graft unions heal.

PERFORMANCE GUIDE:

1. Select plant species, recommended for propagation by back grafting.
2. Select compatible, disease-free scion and stock.
3. Select scion:
    A. Collect scionwood while dormant and hold under refrigeration until needed
    B. Obtain scionwood from shoots (frequently watersprouts) that are approximately 1/2 inch in diameter.
4. Select stock:
    A. Choose branches ranging from 1-4 inches in diameter.
    B. Check stock to insure bark is at the slipping stage, stage in which bark easily separates from wood.
       NOTE: Slipping stage occurs when active growth begins in the spring.
5. Select method of bark grafting to use:
    A. Method 1:
        1. Prepare the stock:
            a. Make a 2 inch vertical cut through the bark and into wood at top of plant stub.
            b. Separate bark from the wood on both sides of the cut by slightly lifting bark with a knife.

PERFORMANCE GUIDE: (cont.)

2. Prepare the scion:
    a. Make a 2 inch vertical cut on one side.
    b. Slice through the bark and into the wood to a depth no greater than 1/3 the diameter of the scion.
    c. Remove the sliced portion of wood, leaving a "shoulder" at the top:
        1. Make a short, slanting cut on opposite side of stem, so the end of the stem is wedge shaped.
        2. Repeat preparation steps on 2 more pieces of scionwood.
3. Insert scions into stock:
    NOTE: Cambial regions of both the scion and stock must be in close contact with each other.
    a. Place the side of the scion with the long cut next to the stock.
    b. Push scion between bark and wood at the prepared cut on the scion.
    c. Rest the scion's "shoulder" on top of stub.

B. Method 2:
    1. Prepare the stock:
        a. Make a slot on stock by removing bark:
            NOTE: The width of slot must equal the width of the scion.
        1. Make parallel vertical 2 inch long cuts through bark.
        2. Connect vertical cuts by making a horizontal cut.
        3. Remove piece of bark in slot, leaving a small (approximately 1/2 inch) flap.
    2. Prepare the scion:
        a. Cut the basal end of scion off, using a smooth slanting cut.
            NOTE: Slanting cut should be approximately 2 inches long.
        b. Slide scion into slot, so scion fits tightly and end of scion fits under the flap.
            NOTE: Cambial regions of both the scion and stock must be in close contact with each other.

6. Secure scion.
7. Cover the grafted stub and union with grafting wax.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using bark grafting.

ENABLER

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using bark grafting.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected compatible, disease-free scion and stock.		
2.	Collected scion wood while dormant.		
3.	Obtained scion wood that was approximately 1/2 inch in diameter.		
4.	Chose branches ranging from 1-4 inches in diameter for stock.		
5.	Checked stock to insure bark was at the slipping stage.		
6.	Prepared bark and scion:		
Bark grafting method 1:			
7.	Made a 2 inch vertical cut through the bark and into the wood at top of plant stub.		
8.	Separated bark from the wood on both sides of the cut.		
9.	Made a 2 inch vertical cut on one side of the section.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Sliced through the bark and into the wood to a depth no greater than 1/3 the diameter of the scion.		
11. Removed the sliced portion of wood, leaving a "shoulder" at the top.		
12. Placed the side of the scion with the long cut next to the stock.		
13. Pushed scion between bark and wood at the prepared cut on the scion.		
14. Rested the scion's "shoulder" on top of stub.		
Bark grafting method 2:		
15. Made a slot on stock by removing bark.		
16. Cut the basal end of scion off, using a smooth slanting cut.		
17. Slid scion into slot, so scion fit tightly and end of scion fit under the flap.		
18. Secured scion.		
19. Covered the grafted stub and union with grafting wax.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 57

TASK: Propagate plants using bridge grafting.

STANDARD OF PERFORMANCE OF TASK:

The scion must be grafted into prepared slot of equal width on stock to form a bridge and repair damage to trunk. The length of scion must equal the distance from top of slots above the wound to bottom of slot below the wound. The scion must fit tightly with stock, so cambial regions are in close contact with each other. The graft union must be secured and covered with grafting wax.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Hammer
Nails
Stock
Scionwood
Grafting wax
Disinfested knife

ENABLING OBJECTIVES:

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

*RESOURCES: (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Propagating plants using bridge grafting.

TEACHING ACTIVITIES:

1. Outline procedure used to propagate plants using bridge. (* 1,2,3 & 4)
2. Present lecture on reasons why bridge grafting is performed. (* 1,2,3 & 4)
3. Present lecture on the stage of growth during which bridge grafting is performed (* 1,2,3,4 & 5)
4. Discuss the importance of selecting healthy plants. (* 6,7, & 8)
5. Present lecture on graft compatibility between and within families, genera, species, varieties and clones. (* 1,2,3,4,9 & 10)
6. Question students on knife safety.
7. Present lecture on grafting tool disinfestation procedures. (* 1,2,3,4,9 & 10)
8. Show examples of prepared stock and scion.
9. Question students on stage of growth during which bridge grafting is performed.
10. Demonstrate how to prepare the stock.
11. Demonstrate how to prepare the scion.
12. Demonstrate how to insert the scion into the stock.
13. Question students on the degree to which the bark is at the slipping stage.
14. Discuss the importance of cambial alignment.
15. Demonstrate how to secure the graft union.

TEACHING ACTIVITIES: (cont.)

16. Demonstrate how to cover the entire graft union with grafting wax.
17. Question students on knife safety.
18. Discuss the importance of grafting tool disinfestation.
19. Monitor students as they practice bridge grafting.
20. Assign each student a plant(s) to propagate using bridge grafting. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the time of year and/or stage of growth when grafting should be performed, select healthy, disease-free stock and scion, place the cambial layers in close contact (following bridge grafting procedures) and protect the graft union from drying. The graft union must not be allowed to dry out and 50% of the graft unions heal.

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation, using bridge grafting.
2. Obtain plant which has received an injury to the trunk, but still has a healthy root system.
3. Prepare the stock in early spring, when bark is slipping:
    A. Remove all dead or damaged bark away from plant wound.
    B. Trim bark back into the healthy bark.
    C. Cut slots through the bark at the top of wound at 2-3 inch intervals.
    NOTE: Slots are made by making 2 parallel vertical cuts through the bark and removing the bark in between the cuts.
    D. Make slots at bottom of the wound directly below the slots just made.
4. Prepare scion:
    A. Obtain scionwood from healthy, disease-free, dormant plant of compatible species.
    B. Remove scion from one year old growth, whose stem diameter measures 1/4 to 1/2 inch.
    C. Make a long slanting cut at both ends of the scion.
    NOTE: The two cuts must be made on the same side of scion.
    D. Make a short slanting cut on back side of previous cuts, so ends form a sharp wedge.
    E. Remove any buds from scion.

PERFORMANCE GUIDE: (cont.)

5. Insert scion into the stock:
    A. Insert a scion into each slot, so scion bows slightly outward.
        NOTE: Make sure scion is inserted right side up.
    B. Nail scion in place at top and bottom of scionwood.
6. Cover cut surface of graft and wounded area with grafting wax.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using bridge grafting.

ENABLER

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using bridge grafting.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Removed all dead or damaged bark away from plant wound.	______	______
2.	Trimmed bark back into the healthy bark.	______	______
3.	Cut slots through the bark at the top of wound at 2-3 inch intervals.	______	______
4.	Made slots at bottom of the wound.	______	______
5.	Obtained scionwood from healthy, disease-free, dormant plant of compatible species.	______	______
6.	Removed scion from one year old growth, whose stem diameter measures 1/4 to 1/2 inch.	______	______
7.	Made a long slanting cut at both ends of the scion.	______	______
8.	Made a short slanting cut on back side of previous cuts to form a sharp wedge.	______	______
9.	Removed any buds from scion.	______	______
10.	Inserted a scion into each slot.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
11. Nailed scion in place at top.	________	________
12. Covered cut surface of graft and wounded area with grafting wax.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 58

TASK: Propagate plants using cleft grafting.

STANDARD OF PERFORMANCE OF TASK:

The basal portion of the scion must form a wedge with one edge of wedge thicker than the other side. The scion must be inserted into the prepared split on stock and held in place by the pressure of the stock. The outside of the scion must be set slightly in from the outer side of the stock. The cambial regions on the scion and stock must make close contact with each other. The graft union, stub, and scion must be covered with grafting wax.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Stock
Scion
Mallet
Wedge
Heavy knife
Screwdriver
Grafting wax

ENABLING OBJECTIVES:

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.

***RESOURCES:** (cont.)

4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Propagating plants using cleft grafting.

TEACHING ACTIVITIES:

1. Outline procedure used to propagate plants using cleft grafting. (* 1,2,3 & 4)
2. Present lecture on reasons why cleft grafting is performed. (* 1,2,3 & 4)
3. List plants that are propagated using cleft grafting. (* 1,2,3,4 & 5)
4. Present lecture on the stage of growth (activity) growing during which cleft grafting is performed. (* 1,2,3, & 4)
5. Present lecture on the preparation and/or storage of scion wood. (* 1,2,3 & 4)
6. Show examples of scion wood that has been stored.
7. Present lecture on storage requirements of scion wood.
8. Discuss the importance of selecting healthy plants. (* 6,7 & 8)
9. Present lecture on graft compatibility between and within families, genera, species, varieties and clones. (* 1,2,3,4,9 & 10)
10. Question students on knife safety.
11. Present lecture on grafting tool disinfestation procedures. (* 1,2,3,4,9 & 10)
12. Show examples of prepared stock and scion.

TEACHING ACTIVITIES: (cont.)

13. Question students on stage of growth during which cleft grafting is performed.
14. Demonstrate how to prepare the scion.
15. Demonstrate how to prepare the stock.
16. Demonstrate how to insert the scion into the stock.
17. Discuss the importance of cambial alignment.
18. Demonstrate how to cover the entire graft union with grafting wax.
19. Question students on knife safety.
20. Discuss the importance of grafting tool disinfestation.
21. Monitor students as they practice cleft grafting.
22. Assign each student a plant(s) to propagate using cleft grafting. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the time of year and/or stage of growth when grafting should be performed, select healthy, disease-free stock and scion, place the cambial layers in close contact (following cleft grafting procedures) and protect the graft union from drying. The graft union must not be allowed to dry out and 50% of the graft unions heal.

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by cleft grafting.
2. Select compatible, disease-free stock:
   NOTE: Species used as stock must have straight-grain wood, that will split easily.
   - A. Check branches for bud swelling in early spring.
     NOTE: Cleft grafting may be done any time during the dormant season, but success rate is highest during bud swelling stage.
   - B. Choose branches generally 1-4 inches in diameter.
   - C. Saw off branch at a right angle to the main axis of the branch, so the stub to be grafted remains.
     NOTE: End of stub must be smooth and free of knots.

PERFORMANCE GUIDE: (cont.)

3. Select compatible, disease-free scion:
    - A. Collect scion from dormant one-year-old wood.
      NOTE: Scion may need to be collected early and held under refrigeration until used.
    - B. Collect scions 3-4 inches long, 3/8-1/2 inch thick, with 2-3 buds.
4. Prepare the stock:
    - A. Split stub vertically by pounding a heavy knife into the stub:
        1. Position the knife, so split will be through the center of stub.
        2. Pound knife 2-3 inches into stub.
    - B. Insert screwdriver, wedge, or grafting tool into the top of the split to hold it open.
5. Cut basal point of scion so it forms a wedge, approximately 2 inches long, with one edge of wedge thicker than the other side.
   NOTE: The wedge does not have to be pointed.
6. Insert 2 scions into the split on opposite sides of stock:
    - A. Place scions so the wider edge is on the outer side of stock.
    - B. Set the outside of scion slightly in from the outer side of stock, so close cambium contact exists between stock and scion.
    - C. Remove screwdriver, wedge, or grafting tool, so the weight of the split stock holds the scion tightly in place.
      NOTE: The pressure of the stock should hold the scion so tightly, that it cannot be removed by hand.
7. Cover all cut areas on the scion and stub with grafting wax.
8. Check graft after 2-3 days and rewax, if necessary.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using cleft grafting.

ENABLER

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**_________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using cleft grafting.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Selected compatible, disease-free stock.		
2.	Checked branches for bud swelling.		
3.	Chose branches 1-4 inches in diameter.		
4.	Sawed off branch.		
5.	Selected disease-free scion.		
6.	Collected scion from dormant one-year-old wood.		
7.	Collected scions 3-4 inches long, 3/8-1/2 inch thick, with 2-3 buds.		
8.	Split stub vertically by pounding a heavy knife 2-3 inches into stub.		
9.	Cut basal point of scion to form a wedge.		
10.	Inserted 2 scions into the split on opposite sides of stock.		
11.	Set the scion for close cambium contact.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
12. Covered all cut areas on the scion and stub with grafting wax.	________	________
13. Checked graft after 2-3 days and rewaxed, if necessary.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 59

TASK: Propagate plants using inarch grafting.

STANDARD OF PERFORMANCE OF TASK:

A six inch vertical slot must be positioned on the plant to be inarched, so a liner will bend and fit into it. The cut surface of the liner must fit tightly into the prepared slot on plant's trunk. Cambial regions must be in close contact with each other. The graft union must be secured and covered with grafting wax.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Practices and Principles.

CONDITIONS FOR PERFORMANCE OF TASK:

Liners
Hammer
Grafting wax
Plant to be inarched
Disinfested knife
Flat-headed wire nails

ENABLING OBJECTIVES:

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Propagating plants using inarch grafting.

TEACHING ACTIVITIES:

1. Outline procedure used to propagate plants using inarch. (* 1,2,3 & 4)
2. Present lecture on reasons why inarch grafting is performed. (* 1,2,3 & 4)
3. List plants that are propagated using inarch grafting. (* 1,2,3,4 & 5)
4. Present lecture on the stage of growth during which inarch grafting is performed. (* 1,2,3, & 4)
5. Discuss the importance of selecting healthy plants. (* 6,7 & 8)
6. Present lecture on graft compatibility between and within families, genera, species, varieties and clones. (* 1,2,3,4,9 & 10)
7. Question students on knife safety.
8. Present lecture on grafting tool disinfestation procedures. (* 1,2,3,4,9 & 10)
9. Show examples of prepared plants with damaged root system and liners.
10. Question students on the stage of growth during which inarch grafting is performed.
11. Demonstrate how to prepare the plant with the damaged root system and the liners.
12. Demonstrate how to lay on the cut in the slot.
13. Discuss the importance of cambial alignment.
14. Demonstrate how to secure the graft union.

TEACHING ACTIVITIES: (cont.)

15. Demonstrate how to cover the entire graft union with grafting wax.
16. Question students on knife safety.
17. Discuss the importance of grafting tool disinfestation.
18. Monitor students as they practice inarch grafting.
19. Assign each student a plant(s) to propagate using inarch grafting. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the time of year and/or stage of growth when grafting should be performed, select healthy, disease-free stock and scion, place the cambial layers in close contact (following inarch grafting procedures) and protect the graft union from drying. The graft union must not be allowed to dry out and 50% of the graft unions heal.

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by inarch grafting.
2. Obtain plant which has a damaged or poor root system but still has a healthy trunk.
3. Plant healthy, disease-free liners of a compatible species whose stem diameter measures 1/4-1/2 inch, at a 5-6 inch spacing next to the trunk of the plant during the dormant season.
4. Prepare the plant to be inarched in early spring:
   A. Make a 6 inch vertical slot at the location where the graft union will take place.
   B. Width of vertical slot must equal the width of the corresponding liner.
   NOTE: Slot is made by making 2 parallel vertical cuts through the bark of the plant.
   C. Leave a small flap of bark at top of slot.
5. Prepare the liner for inarching:
   A. Make a long cut through the bark and slightly into the wood at location where graft union will occur.
   B. Locate cut on side of liner facing the plant.
   C. Match the length of the cut on liner with length of cut on plant to be inarched.
   D. Remove any growth above the location of the graft union.
   E. Make a short cut at tip of liner on the opposite side of first cut to for a wedge.

PERFORMANCE GUIDE: (cont.)

6. Lay the cut on liner in the slot made on plant being inarched:
    A. Insert wedge at the tip of the liner under flap of bark on plant being inarched.
    B. Check liner to insure it fits tightly into slot.
7. Secure the liner in slot.
    NOTE: Nails are usually spaced at intervals the length of the liner to secure it. One nail should be driven through the flap of bark, the wedge at top of seedling, and into plant.
8. Seal entire graft union area with grafting wax.
9. Repeat steps 3-7 with each liner planted at the base of the plant.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using inarch grafting.

ENABLER

1. Recognize healthy disease-free plants.
2. Recognize actively growing and/or dormant plants.
3. Recall knife safety.

STUDENT'S NAME________________________ **DATE**__________

EVALUATOR'S NAME______________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using inarch grafting.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Planted liners.		
2.	Prepared the plant to be inarched.		
3.	Prepared the liner for inarching.		
4.	Laid the cut on liner in the slot made on plant being inarched.		
5.	Secured the liner in slot.		
6.	Sealed entire graft union area with grafting wax.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 60

TASK: Propagate plants using side grafting.

STANDARD OF PERFORMANCE OF TASK:

Stock and scion must be grafted, using the stub graft, side-tongue graft, or side-veneer graft methods of side grafting. The cambial regions on the scion and stock must make close contact with each other. The graft union must be secured and not allowed to dry out, using recommended procedure for specified method.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Mist
Scion
Stock
Mallet
Grafting wax
Budding rubbers
Adhesive tape
Plastic tape
Grafting wax
Grafting case
Moist media
Disinfested knife
Disinfested heavy knife

ENABLING OBJECTIVES:

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.

***RESOURCES:** (cont.)

2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 2). Fort Worth, TX: Branch-Smith Publishing.
5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Side grafting.

TEACHING ACTIVITIES:

1. Present lecture on reasons why side grafting is used as a propagation method. (* 1,2,3 & 4)
2. Outline procedure used to propagate plants using side grafting. (* 1,2,3 & 4)
3. List plant that are propagated by side grafting. (* 1,2,3,4 & 5)
4. List methods of side grafting. (* 1,2,3 & 4)
5. Present lecture on graft compatibility between and within clones, species, genera and families. (* 1,2,3 & 4)
6. Discuss the importance of using healthy, disease free stock and scion. (* 1,2,3,4,9 & 10)
7. Discuss the importance of disinfesting grafting tools. (* 1,2,3,4,9 & 10)
8. Show examples of stock and scion used for side grafting.
9. Question students on the external and internal parts of a woody plant stem. (* 1,2,3,4,6,7 & 8)

TEACHING ACTIVITIES: (cont.)

10. Question students on what plant characteristics they would look for when selecting healthy, disease free plant materials for grafting. (* 1,2,3,4,9 & 10)
11. Show tools and materials used when side grafting. (* 1,2,3 & 4)
12. Demonstrate how to disinfest the grafting tools. (* 1,2,3 & 4)
13. Demonstrate how to perform a stub graft. (* 1,2,3 & 4)
14. Demonstrate how to perform a side-veneer graph. (* 1,2,3 & 4)
15. Demonstrate how to perform a side-tongue graft. (* 1,2,3 & 4)
16. Discuss the importance of cambial layer alignment. (* 1,2,3 & 4)
17. Demonstrate how to secure the graft. (* 1,2,3 & 4)
18. Demonstrate how to protect the graft from drying. (* 1,2,3 & 4)
19. Show examples of successful side graft unions.
20. Question students on knife safety.
21. Question students on grafting tool disinfestation.
22. Monitor students as they practice side grafting.
23. Assign each student a plant species to side graft. (* 11)

CRITERION-REFERENCED MEASURE:

The student must select the plant materials, prepare the stock and scion, put the stock and scion together, secure the graft, and protect the graft from drying. The selected plant materials must be healthy and disease free (test administrator's judgement), the stock and scion must be prepared according to the side grafting method assigned, the cambial layers of the stock and scion must be positioned for maximum contact, the scion must not shift, the graft must not dry out and the graft union must heal (50% of grafts are successful).

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by side grafting.
2. Select healthy, disease-free compatible plants.

PERFORMANCE GUIDE: (cont.)

3. Identify method of side grafting to use:
   A. Stub graft:
      1. Select branches approximately one inch in diameter for stock.
      2. Select scion that is thin, approximately three inches long, and contains 2 - 3 buds.
      3. Prepare stock:
         a. Place heavy knife at a 20°-30° angle with branch.
         b. Pound heavy knife approximately 1/3-1/2 of the way through the branch.
            NOTE: The cut must be positioned so cut will remain closed unless it is pulled open by hand.
      4. Cut the scion's base so it is shaped like a thin wedge.
         NOTE: Cuts must be very smooth.
      5. Insert the scion into the stock:
         a. Separate cut on stock branch by pulling on top of branch.
         b. Insert scion in cut at a slight angle.
            NOTE: Stock must be positioned so maximum cambial contact between stock and scion occurs.
         c. Release top of branch so pressure of the stock holds the scion in place.
         d. Cut top portion of stock branch off just above graft union.
      6. Cover graft union and the cut surfaces with grafting wax.
   B. Side-tongue graft:
      1. Select plant with a smooth portion of stem above the crown for stock.
      2. Select scion that has a slightly smaller diameter.
      3. Prepare the scion:
         a. Make a sloping cut 1-2 1/2 inches long at the base of the scion.
         b. Make an upward cut 1/2 the length of the first cut, at 1/3 of the distance from the tip to the base of the first cut to form a tongue.

PERFORMANCE GUIDE: (cont.)

4. Cut and remove a piece of bark and wood along one side of stock:
    a. Make cut in the smooth portion of stock and at the same length as the cut on the scion.
    b. Make cut approximately 1/4 the way through the stem.
    c. Make a downward cut 1/2 the length of the first cut, starting at top 1/3 of the cut portion of stem to form a tongue.
5. Insert scion into stock, so tongues interlock and cambial layers match.
6. Secure the graft union.
7. Cover graft union with grafting wax.
8. Cut top portion of stock plant off just above the graft union, after the union has healed.

C. Side-veneer graft:
1. Prepare the stock:
    a. Make a long shallow cut approximately 1-1 1/2 inches long in smooth area just above the crown.
    b. Make a second cut at base of first cut:
        1. Position the cut both inward and downward.
        2. Intersect cut with first cut to remove piece of bark and wood.
2. Prepare the scion:
    a. Make a long shallow cut equal in length and width to the long cut on stock.
    b. Make a short slanting cut on opposite side of stem that is equal in length and width to the short cut on stock.
3. Match the long cuts made on scion and stock.
    NOTE: Cambial layers must match and be in close contact with each other.
4. Secure the graft.
5. Protect the graft union from drying out.
6. Remove the portion of stock above the graft union, after the union has healed.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using side grafting.

ENABLER

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

STUDENT'S NAME________________________**DATE**__________

EVALUATOR'S NAME________________________**COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using side grafting.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Selected healthy, disease-free plants for stock and scion.	______	______
2. Disinfested grafting tools.	______	______
3. Performed assigned side-graft.	______	______
Stub graph:		
4. Selected branches approximately one inch in diameter for stock.	______	______
5. Selected scion that was thin, approximately three inches long, and contained 2-3 buds.	______	______
6. Placed heavy knife at a 20°-30° angle with branch.	______	______
7. Pounded heavy knife approximately 1/3-1/2 of the way through the branch such that the cut remained closed until it was pulled open by hand.	______	______
8. Cut the scion's base so it was shaped like a thin wedge.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
9. Cuts were very smooth.		
10. Separated the cut on stock branch.		
11. Inserted the scion in cut at a slight angle.		
12. Positioned stock so maximum cambial contact between stock and scion occurred.		
13. Held scion in place from pressure of the stock.		
14. Cut top portion of stock branch off just above graft union.		
15. Covered graft union and the cut surfaces with grafting wax.		
Side-tongue graft:		
16. Selected plant with a smooth portion of stem above the crown for stock.		
17. Selected scion that had a slightly smaller diameter.		
18. Made a sloping cut 1-2 1/2 inches long at the base of the scion.		
19. Made an upward cut 1/2 the length of the first cut, at 1/3 of the distance from the tip to the base of the first cut to form a tongue.		
20. Made cut in the smooth portion of stock and at the same length as the cut on the scion.		
21. Made cut approximately 1/4 the way through the stem.		
22. Made a downward cut 1/2 the length of the first cut, starting at top 1/3 of the cut portion of stem to form a tongue.		
23. Inserted scion into stock, so tongues interlocked and cambial layers matched.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
24. Secured the graft union.	________	________
25. Covered graft union with grafting wax.	________	________
Side-veneer graft:		
26. Made a long shallow cut approximately 1-1 1/2 inches long in smooth area just above the crown.	________	________
27. Made a second cut at base of first cut positioning the cut both inward and downward. Intersected cut with first cut to removed piece of bark and wood.	________	________
28. Made a long shallow cut equal in length and width to the long cut on stock.	________	________
29. Made a short slanting cut on opposite side of stem that is equal in length and width to the short cut on stock.	________	________
30. Matched the long cuts made on scion and stock.	________	________
31. Matched cambial layers and where in close contact with each other.	________	________
32. Secured the graft.	________	________
33. Protected the graft union from drying.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 61

TASK: Propagate plants using splice grafting.

STANDARD OF PERFORMANCE OF TASK:

The smooth cuts and cambial regions on the scion and the stock must match and be in close contact with each other. The graft union must be secured and not allowed to dry out.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Scionwood
Moist media
Rootstock
Grafting wax
Sharp grafting knife
Adhesive tape
Budding rubber

ENABLING OBJECTIVES:

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Measure diameter

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Splice grafting.

TEACHING ACTIVITIES:

1. Present lecture on reasons why splice grafting is used as a propagation method. (* 1,2,3 & 4)
2. Outline procedure used to propagate plants using splice grafting. (* 1,2,3 & 4)
3. List plant that are propagated by splice grafting. (* 1,2,3,4 & 5)
4. Present lecture on graft compatibility between and within clones, species, genera and families. (* 1,2,3 & 4)
5. Discuss the importance of using health, disease free stock and scion. (* 1,2,3,4,9 & 10)
6. Discuss the importance of disinfesting grafting tools. (* 1,2,3,4,9 & 10)
7. Show examples of stock and scion used for splice grafting.
8. Question students on external and internal parts of a woody plant stem. (* 1,2,3,4,6,7 & 8)
9. Question students on what plant characteristics they would look for when selecting healthy, disease free plant materials for grafting. (* 1,2,3,4,9 & 10)
10. Show tools and materials used when splice grafting. (* 1,2,3 & 4)
11. Demonstrate how to disinfest the grafting tools. (* 1,2,3 & 4)
12. Demonstrate how to perform a splice graft. (* 1,2,3 & 4)

TEACHING ACTIVITIES: (cont.)

13. Discuss the importance of cambial layer alignment. (* 1,2,3 & 4)
14. Demonstrate how to secure the graft. (* 1,2,3 & 4)
15. Demonstrate how to protect the graft from drying. (* 1,2,3 & 4)
16. Show examples of successful splice graft unions.
17. Question students on knife safety.
18. Question students on grafting tool disinfestation.
19. Monitor students as they practice splice grafting.
20. Assign each student a plant species to splice graft. (* 11)

CRITERION-REFERENCED MEASURE:

The student must select the plant materials, prepare the stock and scion, put the stock and scion together, secure the graft, and protect the graft from drying. The selected plant materials must be healthy and disease free (test administrator's judgment), the stock and scion must be prepared according to the splice grafting method, the cambial layers of the stock and scion must be positioned for maximum contact, the scion must not shift, the graft must not dry out and the graft union must heal (50% of grafts are successful).

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by splice grafting.
2. Select compatible, disease-free scion and stock equal in diameter.
   NOTE: Scionwood of deciduous plants is usually collected while buds are dormant in the winter.
3. Make a sloping cut 1-2 1/2 inches long at top of the stock.
4. Make a sloping cut, the same length as the cut made on the stock, at the internode area below two to three buds on the scion.
   NOTE: A mirror image of the stock cut should be made on the scion.
5. Match the cut surfaces of the scion and stock.
   NOTE: Cambial regions of both the scion and stock must match and be in close contact with each other.

PERFORMANCE GUIDE: (cont.)

6. Secure the graft union.
7. Protect the graft union from drying out.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using splice grafting.

ENABLER

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Measure diameter.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using splice grafting.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected disease-free scion and stock equal in diameter.	______	______
2.	Made a sloping cut 1-2 1/2 inches long at top of the stock.	______	______
3.	Made a sloping cut, the same length as the cut made on the stock, at the internode area below two to three buds on the scion.	______	______
4.	Matched the cut surfaces of the scion and stock.	______	______
5.	Secured the graft union.	______	______
6.	Protected the graft union from drying.	______	______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 62

TASK: Propagate plants using wedge grafting.

STANDARD OF PERFORMANCE OF TASK:

The notched shaped scions must be inserted into the "V" shaped cuts on the stock. The scion must fit tightly enough that it would be difficult to remove by hand. The cambial regions on the scion and stock must match and cross slightly. All cut areas must be covered with grafting wax.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Stock
Scion
Mallet
Heavy knife
Screwdriver

ENABLING OBJECTIVES:

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols.1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

*RESOURCES: (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Wedge grafting.

TEACHING ACTIVITIES:

1. Present lecture on reasons why wedge grafting is used as a propagation method. (* 1,2,3 & 4)
2. Outline procedure used to propagate plants using wedge grafting. (* 1,2,3 & 4)
3. List plant that are propagated by wedge grafting. (* 1,2,3,4 & 5)
4. Present lecture on graft compatibility between and within clones, species, genera and families. (* 1,2,3 & 4)
5. Discuss the importance of using health, disease free stock and scion. (* 1,2,3,4,9 & 10) 6. Discuss the importance of disinfesting grafting tools. (* 1,2,3,4,9 & 10)
7. Show examples of stock and scion used for wedge grafting.
8. Question students on external and internal parts of a woody plant stem. (*1,2,3,4,6,7 & 8)
9. Question students on what plant characteristics they would look for when selecting healthy, disease free plant materials for grafting. (* 1,2,3,4,9 & 10)
10. Show tools and materials used when wedge grafting. (* 1,2,3 & 4)
11. Demonstrate how to disinfest the grafting tools. (* 1,2,3 & 4)
12. Demonstrate how to perform a wedge graft. (* 1,2,3 & 4)

TEACHING ACTIVITIES: (cont.)

13. Discuss the importance of cambial layer alignment. (* 1,2,3 & 4)
14. Demonstrate how to secure the graft. (* 1,2,3 & 4)
15. Demonstrate how to protect the graft from drying. (* 1,2,3 & 4)
16. Show examples of successful wedge graft unions.
17. Question students on knife safety.
18. Question students on grafting tool disinfestation.
19. Monitor students as they practice wedge grafting.
20. Assign each student a plant species to wedge graft. (* 11)

CRITERION-REFERENCED MEASURE:

The student must select the plant materials, prepare the stock and scion, put the stock and scion together, secure the graft, and protect the graft from drying. The selected plant materials must be healthy and disease free (test administrator's judgment), the stock and scion must be prepared according to the wedge grafting method, the cambial layers of the stock and scion must be positioned for maximum contact, the scion must not shift, the graft must not dry out and the graft union must heal (50% of grafts are successful).

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by wedge grafting.
2. Select compatible disease-free stock:
   A. Select stock in late winter or early spring, before bark begins to slip.
   B. Choose branches 1-4 inches in diameter.
   C. Saw off branch at a right angle to the main axis of the branch, so stub to be grafted remains.
3. Collect compatible disease-free scion from dormant, one year old wood.
   NOTE: Scion may need to be collected early and held under refrigeration until used.

PERFORMANCE GUIDE: (cont.)

4. Prepare stock:
    A. Pound a heavy knife into side of the stub to form a "V":
        1. Make 2 cuts that are approximately 2 inches long:
            a. The distance between cuts at the top of stub must equal the width of the scion.
            b. The bottom of cuts should form the bottom of the "V".
        2. Make the "V" shaped cut extend approximately 3/4 inch into the side of stub.
    B. Pound screwdriver downward behind the "V" shaped cut to flip out the "V" shaped chip.
5. Cut the basal ends of scion to form a wedge that matches the "V" shaped opening in stock.
6. Insert the scion into the stock:
    A. Position scion into "V" shaped wedge so cambium layers match.
    B. Slant scion slightly outward at the top, so cambium layers cross slightly.
7. Repeat steps 2-6 using one or two more scions.
8. Cover all cut surfaces with grafting wax.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using wedge grafting.

ENABLER

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using wedge grafting.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected compatible disease-free stock.	______	______
2.	Selected stock in late winter or early spring, before bark begins to slip.	______	______
3.	Chose branches 1-4 inches in diameter.	______	______
4.	Sawed off branch at a right angle to the main axis of the branch, so stub that was grafted remains.	______	______
5.	Collected compatible disease-free scion from dormant, one year old wood.	______	______
6.	Pounded a heavy knife into side of the stub to form a "V".	______	______
7.	Made 2 cuts that are approximately 2 inches long.	______	______
8.	Made the distance between cuts at the top of stub equaled to the width of the scion.	______	______
9	Made the bottom of cuts to formed the bottom of the "V".	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Made the "V" shaped cut extend approximately 3/4 inch into the side of stub.	________	________
11. Pounded screwdriver downward behind the "V" shaped cut to flip out the "V" shaped chip.	________	________
12 Cut the basal ends of scion to form a wedge that matched the "V" shaped opening in stock.	________	________
13. Positioned scion into "V" shaped wedge.	________	________
14. Slanted scion slightly outward at the top, so cambium layers cross.	________	________
15. Covered all cut surfaces with grafting wax.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 63

TASK: Propagate plants using whip grafting.

STANDARD OF PERFORMANCE OF TASK:

Cuts must be smooth and must interlock. The cambial regions of the scion and stock must match and be in close contact with each other. The graft union must be secured and not allowed to dry out.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Scionwood
Adhesive tape
Rootstock
Grafting wax
Sharp grafting knife
Moist media
Budding rubber

ENABLING OBJECTIVES:

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Whip grafting.

TEACHING ACTIVITIES:

1. Present lecture on reasons why whip grafting is used as a propagation method. (* 1,2,3 & 4)
2. Outline procedure used to propagate plants using whip grafting. (* 1,2,3 & 4)
3. List plant that are propagated by whip grafting. (* 1,2,3,4 & 5)
4. Present lecture on graft compatibility between and within clones, species, genera and families. (* 1,2,3 & 4)
5. Discuss the importance of using health, disease free stock and scion. (* 1,2,3,4,9 & 10)
6. Discuss the importance of disinfesting grafting tools. (* 1,2,3,4,9 & 10)
7. Show examples of stock and scion used for whip grafting.
8. Question students on external and internal parts of a woody plant stem. (* 1,2,3,4,6,7 & 8)
9. Question students on what plant characteristics they would look for when selecting healthy, disease free plant materials for grafting. (* 1,2,3,4,9 & 10)
10. Show tools and materials used when whip grafting. (* 1,2,3 & 4)
11. Demonstrate how to disinfest the grafting tools. (* 1,2,3 & 4)
12. Demonstrate how to perform a whip graft. (* 1,2,3 & 4)

TEACHING ACTIVITIES: (cont.)

13. Discuss the importance of cambial layer alignment. (* 1,2,3 & 4)
14. Demonstrate how to secure the graft. (* 1,2,3 & 4)
15. Demonstrate how to protect the graft from drying. (* 1,2,3 & 4)
16. Show examples of successful whip graft unions.
17. Question students on knife safety.
18. Question students on grafting tool disinfestation.
19. Monitor students as they practice whip grafting.
20. Assign each student a plant species to whip graft. (* 11)

CRITERION-REFERENCED MEASURE:

The student must select the plant materials, prepare the stock and scion, put the stock and scion together, secure the graft, and protect the graft from drying. The selected plant materials must be healthy and disease free (test administrator's judgment), the stock and scion must be prepared according to the whip grafting method, the cambial layers of the stock and scion must be positioned for maximum contact, the scion must not shift, the graft must not dry out and the graft union must heal (50% of grafts are successful).

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by whip grafting.
2. Select healthy disease-free scion and stock.
   NOTE: Stock and scion must be compatible.
   NOTE: Scionwood of deciduous plants is usually collected, while buds are dormant in the winter.
3. Prepare the stock:
   A. Make a sloping smooth cut 1-2 1/2 inches long at top of the stock.
   B. Make a downward cut 1/2 the length of the first cut at 1/3 of the distance from the tip to the base of the first cut.
4. Prepare the scion:
   NOTE: A mirror image of all the stock cuts should be made on the scion.

PERFORMANCE GUIDE: (cont.)

   - A. Make a sloping cut the same length as the first cut made on the stock at the internode area below two or three buds.
   - B. Make second cut exactly like the second cut on the stock.
- 5. Insert the scion into the stock:
   - 1. Match the cut surfaces of scion and stock.
     NOTE: Cambial regions of both the scion and stock must match and be in close contact with each other.
   - 2. Interlock the tongues (the second cut) of the scion and stock.
- 6. Secure the graft union.
- 7. Protect the graft union from drying out.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using whip grafting.

ENABLER

1. Recognize healthy, disease free plants.
2. Recall external parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using whip and tongue grafting.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected plant species recommended for propagation by whip grafting.	______	______
2.	Selected healthy disease-free scion and stock.	______	______
3.	Made a sloping smooth cut 1-2 1/2 inches long at top of the stock.	______	______
4.	Made a downward cut 1/2 the length of the first cut at 1/3 of the distance from the tip to the base of the first cut.	______	______
5.	Made a sloping cut the same length as the first cut made on the stock at the internode area below two or three buds.	______	______
6.	Made second cut exactly like the second cut on the stock.	______	______
7.	Inserted the scion into the stock.	______	______
8.	Matched the cut surfaces of scion and stock.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
9. Interlocked the tongues (the second cut) of the scion and stock.	______	______
10. Secured the graft union.	______	______
11. Protected the graft union from drying.	______	______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 64

TASK: Propagate plants using T-budding.

STANDARD OF PERFORMANCE OF TASK:

The bud piece must fit tightly in "T" cut on prepared stock. Cambial layers must match and the bud piece must be secured. After the bud union heals, stock above the union must be removed.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Raffia
Budstick
Rootstock
Budding rubber
Parafilm tape
Sharp budding knife

ENABLING OBJECTIVES:

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches).

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - T-budding.

TEACHING ACTIVITIES:

1. Present lecture on reasons why T-budding is used as a propagation method. (* 1,2,3 & 4)
2. Outline procedure used to propagate plants using T-budding. (* 1,2,3 & 4)
3. List plant that are propagated by T-budding. (* 1,2,3,4 & 5)
4. Present lecture on graft compatibility between and within clones, species, genera and families. (* 1,2,3 & 4)
5. Discuss the importance of using healthy, disease free stock and scion. (* 1,2,3,4,9 & 10)
6. Discuss the importance of performing T-budding when the bark on the rootstock is at the "slipping" stage. (* 1,2,3 & 4)
7. Discuss the importance of disinfesting grafting tools. (* 1,2,3,4,9 & 10)
8. Show examples of stock and scion used for T-budding.
9. Question students on external and internal parts of a woody plant stem. (* 1,2,3,4,6,7 & 8)
10. Question students on what plant characteristics they would look for when selecting healthy, disease free plant materials for T-budding. (* 1,2,3,4,9 & 10)
11. Show tools and materials used when T-budding. (* 1,2,3 & 4)

TEACHING ACTIVITIES: (cont.)

12. Demonstrate how to disinfest the grafting tools. (* 1,2,3 & 4)
13. Demonstrate how to perform a T-bud graft. (* 1,2,3 & 4)
14. Discuss the importance of cambial layer alignment. (* 1,2,3 & 4)
15. Demonstrate how to secure the graft. (* 1,2,3 & 4)
16. Demonstrate how to protect the graft from drying. (*1,2,3 & 4)
17. Show examples of successful T-budding graft unions.
18. Question students on knife safety.
19. Question students on grafting tool disinfestation.
20. Monitor students as they practice T-budding.
21. Assign each student a plant species to T-bud. (* 11)

CRITERION-REFERENCED MEASURE:

The student must select the plant materials, prepare the stock and scion, put the stock and scion together, secure the graft, and protect the graft from drying. The selected plant materials must be healthy and disease free (test administrator's judgment), the stock and scion must be prepared according to the T-budding grafting method, the cambial layers of the stock and scion must be positioned for maximum contact, the scion must not shift, the graft must not dry out and the graft union must heal (50% of grafts are successful).

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by T-budding.
2. Determine if bark on rootstock is at the "slipping" stage.
3. Select healthy disease-free rootstocks and budsticks possessing the desired characteristics. NOTE: Budsticks and rootstocks must be compatible.
4. Prepare the stock:
    A. Identify location on stock where budding will occur, generally 2 - 10 inches above the soil level.
    B. Make a vertical cut, approximately one inch long, through the bark.
    C. Make a horizontal cut through the bark at the top of the vertical cut to a length of approximately 1/3 the stock diameter.

PERFORMANCE GUIDE: (cont.)

NOTE: Cuts should be no longer than necessary to accept the bud.

  D. Twist the knife at the completion of the horizontal cut to open the two flaps of bark.

5. Prepare the bud:
   - A. Place knife 1/2 inch below the desired bud, pointing upwards.
   - B. Make a slicing cut under the bark to a distance of one inch above the bud.
   - C. Remove knife with the bud and bark still attached to the budstick.
   - D. Place knife 3/4 inch above the bud.

     NOTE: Size of bud piece should match the size of the "T" cut.
   - E. Make a horizontal cut through the bark.
   - F. Remove bud piece.
6. Insert the bud into the stock:
   - A. Place bud piece above "T" cut on stock.
   - B. Slide bud piece downward under the two flaps of bark, until horizontal cuts of stock and bud piece match.
7. Secure bud union tightly.

   CAUTION: Do not cover bud when securing the bud union.
8. Remove all growth above bud union after bud union heals.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using T-budding.

ENABLER

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches).

STUDENT'S NAME__________________________________**DATE**__________

EVALUATOR'S NAME________________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using T-budding.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Identified if bark on rootstock was at the "slipping" stage.		
2.	Selected healthy disease-free rootstocks and budsticks possessing the desired characteristics.		
3.	Identified location on stock where budding occurred.		
4.	Made a vertical cut, approximately one inch long, through the bark.		
5.	Made a horizontal cut through the bark at the top of the vertical cut to a length of approximately 1/3 the stock diameter.		
6.	Twisted the knife at the completion of the horizontal cut to open the two flaps of bark.		
7.	Placed knife 1/2 inch below the desired bud, pointing upwards.		
8.	Made a slicing cut under the bark to a distance of one inch above the bud.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
9.	Removed knife with the bud and bark still attached to the budstick.		
10.	Placed knife 3/4 inch above the bud.		
11.	Made a horizontal cut through the bark.		
12.	Removed bud piece.		
13.	Placed bud piece above "T" cut on stock.		
14.	Slid bud piece downward under the two flaps of bark, until horizontal cuts of stock and bud matched.		
15.	Secured bud union.		
16.	Removed all growth above bud union after bud union healed.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 65

TASK: Propagate plants using chip budding.

STANDARD OF PERFORMANCE OF TASK:

The bud piece must be the exact same size and shape as the cut made in the stock. The bud piece must fit tightly in cut on the prepared stock. Cambial layers must match and be immediately wrapped and secured with tape. Stock above bud union and tape must be removed when bud growth begins.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Budstick
Rootstock
Plastic tape
Sharp budding knife
Nurseryman's adhesive tape

ENABLING OBJECTIVES:

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

***RESOURCES:**

1. Garner, R. (1979). The grafter's handbook (4th ed.). Boston, MA: Faber and Faber.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
6. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.
7. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.
8. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman and Company.
9. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
10. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
11. Checklist - Chip budding.

TEACHING ACTIVITIES:

1. Present lecture on reasons why chip budding is used as a propagation method. (* 1,2,3 & 4)
2. Outline procedure used to propagate plants using chip budding. (* 1,2,3 & 4)
3. List plant that are propagated by chip budding. (* 1,2,3,4 & 5)
4. Present lecture on graft compatibility between and within clones, species, genera and families. (* 1,2,3 & 4)
5. Discuss the importance of using healthy, disease free stock and scion. (* 1,2,3,4,9 & 10)
6. Discuss the importance of cutting the bud piece to the exact same size and shape as the cut made in the stock.
7. Discuss the importance of disinfesting grafting tools. (* 1,2,3,4,9 & 10)
8. Show examples of stock and scion used for chip budding.
9. Question students on external and internal parts of a woody plant stem. (* 1,2,3,4,6,7 & 8)
10. Question students on what plant characteristics they would look for when selecting healthy, disease free plant materials for chip budding. (* 1,2,3,4,9 & 10)
11. Show tools and materials used when chip budding. (* 1,2,3 & 4)

TEACHING ACTIVITIES: (cont.)

12. Demonstrate how to disinfest the grafting tools. (* 1,2,3 & 4)
13. Demonstrate how to perform a chip bud graft. (* 1,2,3 & 4)
14. Discuss the importance of cambial layer alignment. (* 1,2,3 & 4)
15. Demonstrate how to secure the graft. (* 1,2,3 & 4)
16. Demonstrate how to protect the graft from drying. (* 1,2,3 & 4)
17. Show examples of successful chip bud graft unions.
18. Question students on knife safety.
19. Question students on grafting tool disinfestation.
20. Monitor students as they practice chip budding
21. Assign each student a plant species to chip bud. (* 11)

CRITERION-REFERENCED MEASURE:

The student must select the plant materials, prepare the stock and scion, put the stock and scion together, secure the graft, and protect the graft from drying. The selected plant materials must be healthy and disease free (test administrator's judgment), the stock and scion must be prepared according to the chip budding method, the cambial layers of the stock and scion must be positioned for maximum contact, the scion must not shift, the graft must not dry out and the graft union must heal (50% of grafts are successful).

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by chip budding.
2. Select healthy disease-free rootstock and budsticks of 1/2 to 1 inch in diameter, that possess the desired characteristics.
   NOTE: Budsticks and rootstocks must be compatible.
3. Prepare the stock:
   A. Place knife at the internode section near the base of the stock.
   B. Make a downward cut with knife at a 30°-45° angle to the stock, to a depth of 1/4 the diameter of stock.
   C. Place knife 1 inch above the first cut.
   D. Make a downward and inward cut, until this cut connects with the first cut.

PERFORMANCE GUIDE: (cont.)

4. Prepare the bud piece:
   NOTE: The bud piece must be the exact same size and shape as the cut made in the stock.
   - A. Place knife 1/4 inch below desired bud.
   - B. Make a downward cut with knife at the same angle and depth as the first cut made on the stock.
   - C. Place knife 1/2 inch above the desired bud.
   - D. Make a downward and inward cut behind the bud, until this cut connects with the first cut.
   - E. Remove bud piece.
5. Insert the bud piece into cut made on the stock.
   NOTE: The cambial layers of bud piece and stock must match and fit closely together.
6. Secure and wrap edges of bud piece immediately to prevent unnecessary drying.
7. Cut tape when bud starts growth.
8. Remove stock above bud union, after the bud union is completed.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using chip budding.

ENABLER

1. Recognize healthy, disease free plants.
2. Recall external and internal parts of a woody plant stem.
3. Recall purpose of disinfesting grafting tools.
4. Estimate distance (inches) and angles.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using chip budding.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected plant species recommended for propagation by chip budding.		
2.	Selected healthy disease-free rootstock and budsticks of 1/2 to 1 inch in diameter.		
3.	Prepared the stock:		
	- Placed knife at the internode section near the base of the stock.		
	- Made a downward cut with knife at a 30°-45° angle to the stock, to a depth of 1/4 the diameter of stock.		
	- Placed knife 1 inch above the first cut.		
	- Made a downward and inward cut, until this cut connects with the first cut.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
4. Prepared the bud piece:		
- Placed knife 1/4 inch below desired bud and made a downward cut with knife at the same angle and depth as the first cut made on the stock.		
- Placed knife 1/2 inch above the desired bud and made a downward and inward cut behind the bud, until this cut connects with the first cut.		
- Removed bud piece.		
5. Inserted the bud piece into cut made on the stock.		
6. Wrapped edges of bud piece immediately to prevent unnecessary drying.		
7. Cut tape when bud growth started.		
8. Removed stock above bud union.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 66

TASK: Propagate plants using air layering.

STANDARD OF PERFORMANCE OF TASK:

The desired area of rooting on the stem must be wounded, covered with sphagnum moss, and covered with polyethylene. The plantlet must be cut and removed from stock plant, when an adequate root system is present.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Twist ties
Stock plant
Sphagnum moss
Piece of wood
Adhesive tape
Budding rubber
Polyethylene film
Disinfested knife
Rooting hormone powder

ENABLING OBJECTIVES:

1. Look up recommended propagation procedures for plant.
2. Recognize healthy, disease free stock plants.
3. Recall internal part of a plant stem.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Propagating plants using air layering.

TEACHING ACTIVITIES:

1. Outline procedures used to propagate plants using air layering. (* 1,2 & 3)
2. List plants that are propagated by air layering. (* 1,2,3 & 4)
3. Present lecture on reasons why air layering is used as a propagation method. (* 1,2 & 3)
4. Discuss the importance of using healthy, disease free stock plants.
5. Present lecture on determining the location on the stem, when you desire rooting.
6. Present lecture on the purpose of wounding the stem. (* 1,2 & 3)
7. Show example of stock plants used for air layering.
8. Demonstrate how to wound the stem. (* 1,2 & 3)
9. Present lecture on the purpose rooting hormone. (* 1,2 & 3)
10. Demonstrate how to apply rooting hormone powder to the wound.
11. Present lecture on the purpose of wrapping the wound with sphagnum moss.
12. Demonstrate how to wrap the wound with sphagnum moss and polyethylene film.
13. Demonstrate how to check the moisture content of the sphagnum moss.
14. Show examples of plants that were successfully rooted using air layering.
15. Discuss the importance of adequate rooting prior to cutting the plantlet from the stock plant.
16. Discuss the importance of making a clean smooth cut and avoiding leaving a stub below the roots.
17. Assign each student a plant(s) to propagate using air layering. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select healthy, disease free stock plants, wound the stem, apply rooting hormone, wrap the wound and monitor the moisture content of the sphagnum moss. The wound must be harsh enough to cause callus formation yet not so harsh as to kill

CRITERION-REFERENCED MEASURE: (cont.)

the plant above the wound. The sphagnum moss must not dry out and rooting must occur (at least 50% of air layered plants procedure roots adequate to support plantlet when it is removed from the stock plant).

PERFORMANCE GUIDE:

1. Select plant species recommended for propagating by air layering.
2. Select healthy disease-free stock plant.
3. Identify location on stem, where stem will be cut or girdled.
   NOTE: Generally, stems less than one year old are used.
4. Wound the stem:
   A. Girdle the stem:
      1. Remove a 1/2 to 1 inch strip of bark.
      2. Scrape stem to remove phloem and cambium.
   B. Cut the stem:
      1. Make a slanting upward cut through approximately 2/3 of the stem.
      2. Keep the cut open by inserting sphagnum moss or a thin piece of wood in the cut.
5. Apply rooting hormone powder to wound, if recommended for particular plant species.
6. Place approximately 2 handfuls of moistened sphagnum moss around wound.
   CAUTION: Excess moisture should be squeezed from the sphagnum moss.
7. Wrap polyethylene film around sphagnum moss, so it is completely covered.
8. Secure the two ends of the polyethylene film.
9. Remoisten sphagnum moss periodically, if needed.
10. Remove polyethylene film, when roots are visible.
11. Cut plantlet from stem below plantlet's roots.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using air layering.

ENABLER

1. Look up recommended propagation procedures for plant.
2. Recognize healthy, disease free stock plants.
3. Recall internal part of a plant stem.

STUDENT'S NAME________________________ **DATE**__________

EVALUATOR'S NAME______________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using air layering.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected healthy disease-free stock plant.	______	______
2.	Identified location on stem, where stem will be cut or girdled.	______	______
3.	Wounded the stem:		
	- Removed a 1/2 to 1 inch strip of bark and scraped stem to remove phloem and cambium.	______	______
	OR		
	- Made a slanting upward cut through approximately 2/3 of the stem and kept the cut open.	______	______
4.	Applied rooting hormone powder to wound.	______	______
5.	Placed moistened sphagnum moss around wound.	______	______
6.	Wrapped polyethylene film around sphagnum moss.	______	______

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
7.	Secured the two ends of the polyethylene film.	________	________
8.	Remoistened sphagnum moss as needed.	________	________
9.	Removed polyethylene film, when roots were visible.	________	________
10.	Cut plantlet from stem below plantlet's roots.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 67

TASK: Propagate plants using mound layering.

STANDARD OF PERFORMANCE OF TASK:

Stock plant must be cut 1 inch above soil line during dormant season. The lower 1/2 of the developing new shoots must be covered with loose medium, when shoots reach a total height of 5, 10, and 18 inches. The shoots must be cut close to base of stock plant and removed after rooting has occurred.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Loose media
Stock plant
Shovel
Disinfested knife

ENABLING OBJECTIVES:

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Propagating plants using mound layering.

TEACHING ACTIVITIES:

1. Outline procedures used to propagate plants using mound layering. (* 1,2 & 3)
2. List plants that are propagated by mound layering. (* 1,2,3 & 4)
3. Present lecture on reasons why mound layering is used as a propagation method. (* 1,2 & 3)
4. Discuss the importance of using healthy, disease free stock plants.
5. Present lecture on selection of stock plants.
6. Show example of stock plants that have been planted for mound layering in the next year.
7. Present lecture on time of year to cut back stock plants. (* 4)
8. Present lecture on how to cut back stock plant.
9. Present lecture on appearance of stock plant when new shoots develop.
10. Show an example of the medium used to cover the new shoots.
11. Present lecture on when the new shoots are covered with medium.
12. Show example of plants with shoots that have been covered and have rooted.
13. Discuss the importance of adequate rooting prior to removal of shoots.
14. Discuss the importance of keeping plantlets moist.
15. Assign each student a plant(s) to propagate using mound layering. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select healthy, disease free stock plants, plant the stock plant, cut back the stock plant, cover the new growth with medium and remove the rooted plantlets. The lower 1/2 of the developing new shoots must be covered with loose media, when shoots reach a total height of 5, 10, and 18 inches and the shoots must be cut close to base of stock plant and removed after rooting has occurred.

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by mound layering.
2. Select healthy disease-free stock plants.
3. Plant stock plants which have a stem diameter of approximately 10 millimeters in a loose soil.
   NOTE: Wait until next growing season to start propagation process.

PERFORMANCE GUIDE: (cont.)

4. Cut stock plants back to 1 inch above the ground, before growth starts in the spring.
5. Check plants for the development of new shoots.
6. Cover shoots with a loose media:
   - A. Cover the lower 1/2 of the shoots, when new growth reaches a height of 3-5 inches.
   - B. Cover the lower 1/2 of the shoots again, when shoots reach a height of 8-10 inches.
   - C. Cover lower portion of the shoot, so total depth of loose media is 6-8 inches, when shoots reach a height of 18 inches.
7. Check shoots at the end of the growing season to determine if the shoots have adequate root systems.
8. Remove the loose medium from base of shoots after adequate rooting has occurred.
9. Cut and remove shoots next to base of stock plant immediately after media has been removed.
10. Keep plantlets moist until they can be planted.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagating plants using mound layering.

ENABLER

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**_________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using mound layering.

PERFORMANCE DETERMINANTS	YES	NO
1. Selected healthy disease-free stock plants.	______	______
2. Planted stock plants.	______	______
3. Cut stock plants back to 1 inch above the ground, before growth started in the spring.	______	______
4. Checked plants for the development of new shoots.	______	______
5. Covered shoots with a loose media:		
- Covered the lower 1/2 of the shoots, when new growth reached a height of 3-5 inches.	______	______
- Covered the lower 1/2 of the shoots again, when shoots reached a height of 8-10 inches.	______	______
- Covered lower portion of the shoot, so total depth of loose media is 6-8 inches, when shoots reached a height of 18 inches.	______	______
6. Checked shoots at the end of the growing season.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
7. Removed the loose medium from base of shoots after adequate rooting had occurred.	________	________
8. Cut and removed shoots next to base of stock plant.	________	________
9. Kept plantlets moist until they were planted.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 68

TASK: Propagate plants using trench layering.

STANDARD OF PERFORMANCE OF TASK:

Stock plants must be laid flat in a two inch deep trench, secured, and covered with 1-2 inches of rooting medium. Rooting medium must cover the lower 1/2 of developing shoots. The shoots must be cut and removed from stock plant after rooting has occurred.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Anti-transpirant
Burlap
Media
Wire fasteners
Stock plant
Disinfested knife
Shovel
Rooting media
Wooden pegs

ENABLING OBJECTIVES:

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

***RESOURCES:** (cont.)

4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Propagating plants using trench layering.

TEACHING ACTIVITIES:

1. Outline procedures used to propagate plants using trench layering. (* 1,2 & 3)
2. List plants that are propagated by trench layering. (* 1,2,3 & 4)
3. Present lecture on reasons why trench layering is used as a propagation method. (* 1,2 & 3)
4. Discuss the importance of using healthy, disease free stock plants.
5. Present lecture on the time of year to plant stock plant for trench layering. (* 1,2 & 3)
6. Show example of stock plants used for trench layering.
7. Demonstrate how to plant stock plants for trench layering. (* 1,2 & 3)
8. Present lecture on how to cut back stock plant.
9. Present lecture on time of year to begin the propagation process. (* 1,2 & 3)
10. Demonstrate how to lay in a trench and secure it. (* 1,2 & 3)
11. Demonstrate how to cover the stock plant with soil. (* 1,2 & 3)
12. Show example of stock plants with new growth that has rooted.
13. Discuss the importance of adequate rooting prior to removal of shoots.
14. Discuss the importance of keeping plantlets moist.
15. Assign each student a plant(s) to propagate using trench layering. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select healthy, disease free stock plants, plant the stock plant, cut back the stock plant, lay the stock plant in a trench cover the stock with medium and remove the shoots when roots develop. The rooting medium must cover the lower 1/2 of the developing shoots until rooting has occurred and the rooted shoots must be cut and removed from the stock plant after rooting has occurred.

PERFORMANCE GUIDE:

1. Identify plant species recommended for propagation by trench layering.
2. Select healthy disease-free stock plants.
3. Plant one year old stock plants in early spring at an angle of 30°-45°.
4. Cut back stock plants to a uniform length of approximately 18 to 24 inches.
   NOTE: Wait until next growing season to start propagation process.
5. Dig a 2 inch deep trench next to stock plant.
6. Trim shoots slightly in early spring.
7. Lay plant flat in the bottom of the trench, before new growth begins in early spring.
8. Secure plant with wooden pegs or wire fasteners.
9. Cover plant with 1-2 inches of rooting media before its buds swell.
10. Apply additional media, after the shoots emerge.
11. Repeat media application, until half of the shoot is covered and total media depth reaches 6-8 inches.
12. Check shoots at the end of the growing season to determine if the shoots have adequate root systems.
13. Remove rooting media from trench after adequate rooting has occurred.
14. Cut and remove shoots from stock plants.
15. Protect plantlets from drying, until they can be planted.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using trench layering.

ENABLER

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.

STUDENT'S NAME ______________________ **DATE** __________

EVALUATOR'S NAME ______________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using trench layering.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected healthy disease-free stock plants.		
2.	Planted one year old stock plants in early spring at an angle of 30°-45°.		
3.	Cut back stock plants to a uniform length of approximately 18 to 24 inches.		
4.	Dug a 2 inch deep trench next to the stock plant.		
5.	Trimmed shoots slightly in early spring.		
6.	Laid plant flat in the bottom of the trench, before new growth began in the early spring.		
7.	Secured plant with wooden pegs or wire fasteners.		
8.	Covered plant with 1-2 inches of rooting media before its buds swelled.		
9.	Applied additional medium, after the shoots emerged.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Repeated medium application, until half of the shoots length were covered and total medium depth reached 6-8 inches.	_______	_______
11. Checked shoots at the end of the growing season.	_______	_______
12. Removed rooting medium from trench after adequate rooting had occurred.	_______	_______
13. Cut and removed shoots from stock plants.	_______	_______
14. Protected plantlets from drying.	_______	_______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 69

TASK: Propagate plants using serpentine layering.

STANDARD OF PERFORMANCE OF TASK:

Low flexible branches from stock plants must be bent to the ground, secured, and buried with 1-2 inches of soil. The shoots must be cut and removed from stock plant, after rooting has occurred.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Burlap
Media
Stakes
Stock plant
Shovel
Disinfested knife
Anti-transpirant

ENABLING OBJECTIVES:

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Propagating plants using serpentine layering.

TEACHING ACTIVITIES:

1. Outline procedures used to propagate plants using serpentine layering. (* 1,2 & 3)
2. List plants that are propagated by serpentine layering. (* 1,2,3 & 4)
3. Present lecture on reasons why serpentine layering is used as a propagation method. (* 1,2 & 3)
4. Discuss the importance of using healthy, disease free stock plants.
5. Present lecture on selection of branches for serpentine layering. (* 1,2 & 3)
6. Show example of plants that can be used for serpentine layering.
7. Demonstrate how to bend shoots to the ground. (* 1,2 & 3)
8. Demonstrate how to dig a small hole where the shoot touches the ground.
9. Demonstrate how to secure the shoot to the ground. (* 1,2 & 3)
10. Demonstrate how to bury the shoot. (* 1,2 & 3)
11. Show examples of plants with shoots that have produced roots.
12. Discuss the importance of adequate rooting prior to removal of shoots.
13. Discuss the importance of keeping plantlets moist.
14. Assign each student a plant(s) to propagate using serpentine layering. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select healthy, disease free stock plants, bend shoots to the ground, and bury the shoots where they touch the ground and remove the rooted shoots. The shoots must remain buried with 1-2 inches of soil until rooting has occurred and the rooted shoots must be cut and removed from the stock plant after rooting has occurred.

PERFORMANCE GUIDE:

1. Identify plant species recommended for propagation by serpentine layering.
2. Select healthy disease-free dormant stock plants in the early spring.
3. Select low, flexible, one year old branches, which can be bent to the ground.
4. Bend shoot to the ground at intervals, so each shoot touches the ground at several locations.
5. Dig a small hole, 1-2 inches deep, at locations where shoot touches the ground.

PERFORMANCE GUIDE: (cont.)

6. Secure the shoot to the ground at locations where shoot touches the ground with wooden or wire stakes.
7. Bury the shoot with 1-2 inches of soil at locations where shoot is secured.
8. Check shoots at end of growing season to determine if the shoots have adequate root systems.
9. Remove soil from shoots after adequate rooting has occurred.
10. Cut and remove each rooted shoot from the stock plant after media has been removed.
11. Protect plantlets from drying out until they can be planted.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants using serpentine layering.

ENABLER

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.

STUDENT'S NAME____________________**DATE**__________

EVALUATOR'S NAME____________________**COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants using serpentine layering.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected healthy disease-free dormant stock plants.		
2.	Selected low, flexible, one year old branches, which could be bent to the ground.		
3.	Bent shoot to the ground at intervals, so each shoot touched the ground at several locations.		
4.	Dug a small hole, 1-2 inches deep, at locations where shoots touched the ground.		
5.	Secured the shoots to the ground at locations where shoots touched the ground.		
6.	Buried the shoots with 1-2 inches of soil at locations where shoots were secured.		
7.	Checked shoots at end of growing season.		
8.	Removed soil from shoots after adequate rooting had occurred.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
9. Cut and removed each rooted shoot from the stock plant.		
10. Protected plantlets from drying.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 70

TASK: Propagate plants by division.

STANDARD OF PERFORMANCE OF TASK:

Top portion of plant sections must be proportionate with root system. The plant section must not be allowed to dry out until it has become established.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles And Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Shovel
Spade
Stock plant
Disinfested knife

ENABLING OBJECTIVES:

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.
3. Prune plant's foliage.

***RESOURCES:**

1. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
2. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
3. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
4. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Propagating plants by division.

TEACHING ACTIVITIES:

1. Outline procedures used to propagate plants by division. (* 1,2 & 3)
2. List plants that are propagated by division. (* 1,2,3 & 4)
3. Present lecture on reasons why division is used as a propagation method. (* 1,2 & 3)
4. Discuss the importance of using healthy, disease free stock plants.
5. Present lecture on determining the time of year best suited for division of a particular plant species. (* 1,2 & 3)
6. Show example of plants that can be used for division.
7. Demonstrate how to dig up the stock plant.
8. Demonstrate how to cut the plant into sections.
9. Present lecture on the reason for pruning the foliage.
10. Demonstrate how to prune the foliage of the plant.
11. Demonstrate how to replant the sections of the plant.
12. Show examples of the plants propagation by division.
13. Discuss the importance of keeping the plant's roots moist until it is established.
14. Assign each student a plant(s) to propagate by division. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select healthy, disease free stock plants, dig up the stock plant, cut the plant into sections, prune the plant's foliage and replant the sections. The top portion of the plant sections must be proportionate with the root system and the plant sections must not be allowed to dry out until they have become established.

PERFORMANCE GUIDE:

1. Select plant species recommended for propagation by division.
2. Select healthy disease-free stock plants.
3. Identify season of year particular plant species is best suited for crown division:
   A. Divide spring and early summer blooming plants in early fall.
   B. Divide late summer and fall blooming plants in early spring.
   C. Divide continuously blooming plants anytime.

PERFORMANCE GUIDE: (cont.)

4. Dig plant.
5. Cut plant into sections with knife or shovel.
   CAUTION: Each section must possess an adequate root system.
6. Prune approximately 1/3 of the foliage from plant section.
7. Replant sections, immediately after plant has been divided.
8. Keep plant's roots moist until it is established.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Propagate plants by division.

ENABLER

1. Look up recommended propagation method for plant.
2. Recognize healthy, disease free plants.
3. Prune plant's foliage.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to propagate plants by division.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected healthy disease-free stock plants.		
2.	Listed the season of year best suited for crown division of the particular plant species.		
3.	Dug plant.		
4.	Cut plant into sections.		
5.	Pruned approximately 1/3 of the foliage from plant section.		
6.	Replanted sections.		
7.	Kept plant's roots moist until it was established.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 71

TASK: Set time clocks for mist system.

STANDARD OF PERFORMANCE OF TASK:

The day/night and interval time clocks must be set so mist system operates at predetermined intervals during daylight hours.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Time clock
Manufacturer's instructions

ENABLING OBJECTIVES:

1. Measure time (minutes, seconds).
2. Recall seasonal changes in day length and weather.
3. Identify mist requirements of crops.
4. Read time clock instructions.

***RESOURCES:**

1. Time clock instructions.
2. Israelsen, O., & Hansen, V. (1980). Irrigation principles and practices. Fort Atkinson, WI: Nasco.
3. Checklist - Setting time clocks for mist systems.

TEACHING ACTIVITIES:

1. Outline procedures used to set time clocks. (* 1 & 2)
2. Present lecture on the purpose of mist systems.
3. Present lecture on changes in the requirements for mist as seasons change and crops develop.
4. Demonstrate how to set time clocks.
5. Demonstrate how to test time clocks.
6. Assign students to set and test a time clock.
7. Discuss the importance of monitoring the condition of the crop.
8. Assign each student a time clock to set. (* 3)

CRITERION-REFERENCED MEASURE:

The student must set the day/night and interval time clocks. The day/night clock must operate as assigned (plus or minus 15 minutes) and the interval time clock must operate as assigned (plus or minus 2 seconds).

PERFORMANCE GUIDE:

1. Examine the specific time clock system.
2. Read manufacturer's instructions for specific system.
   NOTE: Most time clock systems use two clocks: a day/night clock and an interval clock. Together they operate an intermittent fog/mist system.
3. Set day/night (24 hour) time clock:
   A. Set the time the mist system will be turned on in the morning.
   B. Set the time the mist system will be turned off in the evening.
4. Set the interval the mist system will be off during the day on the interval clock.
5. Adjust the time clocks periodically:
   A. Adjust length of day on the day/night clock as day length changes.
   B. Adjust interval the mist system will be off as the seasons and crops change.
   C. Adjust interval the mist system will be off as daily weather patterns change.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Set time clocks for mist system.

ENABLER

1. Measure time (minutes, seconds).
2. Recall seasonal changes in day length and weather.
3. Identify mist requirements of crops.
4. Read time clock instructions.

STUDENT'S NAME______________________________ **DATE**____________

EVALUATOR'S NAME____________________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to set time clocks for a mist system.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Set the time the mist system will be turned on in the morning.		
2.	Set the time the mist system will be turned off in the evening.		
3.	Set the interval the mist system will be off during the day on the interval clock.		
4.	Set the duration of the mist.		
5.	Adjusted length of day on the day/night clock as day length changes.		
6.	Adjusted interval the mist system will be off as the seasons and crops change.		
7.	Adjusted interval the mist system will be off as daily weather patterns change.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
8. Adjusted the time clocks periodically:		
- Adjusted length of day on the day/night clock as day length changes.	________	________
- Adjusted interval the mist system will be off as the seasons and crops change.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 72

TASK: Identify spacing for species during propagation.

STANDARD OF PERFORMANCE OF TASK:

Plants must be spaced according to plant species' established recommendations, propagule/plantlet size, estimated length of propagation, environmental factors, and available space.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Propagules/plantlets
Plant propagation schedule
Past propagation records

ENABLING OBJECTIVES:

1. Read propagation schedule.
2. Look up propagation method.

***RESOURCES:**

1. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
2. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
3. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.
4. Plant propagation schedule.
5. Past propagation records.
6. Checklist - Determining spacing for species during propagation.

TEACHING ACTIVITIES:

1. Show examples of propagules placed at good and/or poor spacing.
2. List problems associated with improper spacing. (* 1,2, & 3)
3. List environmental factors that effect spacing. (* 1,2 & 3)
4. Present lecture on factors that limit optimum spacing (i.e. facilities)
5. Show examples of a propagation bench and propagules.
6. Question students on their estimation of the size of the root system needed for a particular species.
7. Show examples of propagules with roots.
8. Present lecture on different types of root systems and their effect on spacing. (* 1,2 & 3)
9. List resources available to help determine spacing.
10. Present lecture on use of past propagation records to help determine spacing. (* 4)
11. Present lecture and determine the length of time the propagules will be on the bench/bed. (* 5)
12. Present lecture on spacing for propagules that will remain in the bed/bench for extended periods of time. (* 1,2,3,4 & 5))
13. Present lecture on the effect of air circulation, humidity and bottom heat. (* 1,2 & 3)
14. Present a lecture on the size of a hypothetical or real propagule to be placed within the hypothetical or real propagation area.
15. Assign students to look up the recommended spacing for a particular propagule.
16. Question students on the spacing they would recommend for the particular propagule in the hypothetical or real propagation area.
17. Discuss the reasons behind the students' recommendations for spacing.
18. Assign each student a propagation facility and a list of plant species for which to determine spacing during propagation. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the environmental factors effecting the spacing and record the selected spacing for the species during propagation. The listed environmental factors must include air circulation, availability of mist, fog, and bottom heat/and the degree of sanitation possible. The recorded recommended spacing must be consistent with the resource materials.

PERFORMANCE GUIDE:

1. Obtain plant propagation schedule.
2. Identify method of propagation to be used for particular plant species.
3. Check reference manual to determine if spacing recommendations during propagation for particular plant species have been established.
4. Obtain past plant propagation records.
5. Check past plant propagation records to determine past spacing and degree of success.
6. Estimate size of propagule/plantlet:
   - A. Consider actual size of propagule/plantlet.
   - B. Consider amount of foliage associated with propagule/plantlet.
   - C. Consider aspects of root system when plantlets are removed from propagation bench:
     1. Determine size of root system.
     2. Determine type of root system:
        - a. Stringy.
        - b. Dense.
        - c. Fine.
        - d. Brittle.
7. Estimate length of time propagules/plantlets will be in propagation bench.
8. Check environmental factors:
   - A. Air circulation.
   - B. Propagation system:
     1. Mist.
     2. Fog.
     3. Other.
   - C. Availability of bottom heat.
   - D. Sanitation.

     CAUTION: Disease can spread more quickly at a closer spacing.
9. Evaluate available propagation space.
10. Establish propagation spacing for particular plant species:
    - A. Evaluate plantlet size, estimated propagation time, environmental conditions, recommendations, and compare with amount of space available.
    - B. Space propagules/plantlets at the closest spacing possible that will produce healthy plantlets.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Identify spacing for species during propagation.

ENABLER

1. Read propagation schedule.
2. Look up propagation method.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to determine spacing for species during propagation.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Listed the recommended method of propagation for the plant species.		
2.	Listed the recommended spacing during propagation.		
3.	Obtained past plant propagation records.		
4.	Listed past spacing and degree of success.		
5.	Listed the estimated size of propagule/plantlet.		
6.	Listed the size of the root system.		
7.	Listed the type of root system.		
8.	Listed the estimated length of time in propagation bench.		
9.	Listed air circulation.		
10.	Listed propagation system.		
11.	Listed availability of bottom heat.		
12.	Listed degree of sanitation/available.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
13. Listed available propagation space.	________	________
14. Listed propagation spacing.	________	________
15. Produced healthy plantlets.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 73

TASK: Prepare tissue culture growing medium.

STANDARD OF PERFORMANCE OF TASK:

A recommended medium for particular plant species and specified stage of tissue culture must be mixed, dispensed into culture vessels, capped, and sterilized. Medium must contain the recommended level of nutrients and be adjusted to the recommended pH level for the specified plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.
Plants From Test Tubes An Introduction to Micropropagation.
Introduction to In Vitro Propagation.

CONDITIONS FOR PERFORMANCE OF TASK:

Pipette
Label
Beakers
Autoclave
Pressure cooker
Magnetic stirrer
Erlenmeyer flasks
Volumetric flasks
Analytical balance
pH Meter or pH paper
Pen with indelible ink
Distilled/deionized water
Premixed package of medium
Culture vessels and caps
Tissue culture medium recipe
Racks for culture vessels
Hotplate/stirrer or range top
Chemicals specified by tissue culture medium recipe

ENABLING OBJECTIVES:

1. Recall hazard of impurities in undistilled water.
2. Recall disinfestation solution and disinfestation equipment safety.

ENABLING OBJECTIVES: (cont.)

3. Recall units of measurement. (volume/weight)
4. Read sterilization equipment operating instructions.
5. Label tissue culture medium vessels.
6. Recall chemical safety.

*RESOURCES:

1. Wetherell, D. (1982). Introduction to in vitro propagation. Wayne, NJ: Avery.
2. Kyte, L. (1983). Plants from test tubes an introduction to micropropagation. Portland, OR: Timber Press.
3. Evans, D., Sharp, W., Ammirato, P., & Yamada, Y. (Eds.). (1983). Handbook of plant cell culture (Vols. 1-4). New York, NY: Macmillan.
4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
5. Premixed culture medium instruction.
6. Sterilization equipment operating instructions.
7. Checklist - Preparing tissue culture medium.

TEACHING ACTIVITIES:

1. Show examples of tissue culture growing media.
2. Show examples of lab setups and equipment.
3. Outline overall procedures used to prepare tissue culture growing medium. (* 1,2,3,4 & 5)
4. Discuss the importance of accurate measurement.
5. Question students on chemical safety.
6. Discuss the importance of making sure stock solutions are fresh and not cloudy.
7. Discuss the problems associated with preparing too much or too little growing medium.
8. Discuss the importance of rinsing all equipment and containers with distilled water.
9. Demonstrate how to measure the growing medium ingredients and or mix a premixed culture medium with distilled water.
10. Demonstrate how to test and/or adjust the pH of the culture medium. (* 1,2,3,4 & 5)
11. Demonstrate how to heat the culture medium if a solidifying agent is to be used. (* 1,2,3,4 & 5)
12. Demonstrate how to stir the culture medium and monitor the temperature of the growing medium.
13. Present lecture on problems associated with overheating the culture medium. (* 1,2,3,4 & 5)
14. Present lecture on methods used to dispense the growing medium.

TEACHING ACTIVITIES: (cont.)

15. Demonstrate how to dispense the medium into culture vessels and cap the culture vessels.
16. Question students on the purpose of using an autoclave or pressure cooker.
17. Question students on sterilization equipment safety. (* 5)
18. Present lecture on storage requirements of the sterilized vessels of medium. (* 1,2,4 & 5)
19. Demonstrate how to label and store the sterilized vessels of medium.
20. Assign each student a tissue culture medium recipe to prepare. (* 7)

CRITERION-REFERENCED MEASURE:

The student must measure and mix the culture medium ingredients, test and/or adjust the pH of the medium, heat the mixture, dispense the medium into culture vessels, sterilize the medium, and label and store the culture vessels. The prepared medium must contain the specified level of nutrients and test at the specified pH level. The labels must be complete and legible, the sterilized vessels must be stored as assigned and visual evidence of contamination (microorganisms) must not occur during storage.

PERFORMANCE GUIDE:

1. Select a recommended culture medium formulation for particular plant species and stage of tissue culture.
2. Estimate the quantity of specified culture medium needed for particular transfer operation.
3. Select method of mixing the specified culture medium:

   CAUTION: All equipment and containers, that come in contact with the culture medium should be cleaned and rinsed with distilled water before using.

   A. Use a premixed package of culture medium to produce the culture medium:

      NOTE: Follow the manufacturer's instructions, when mixing culture medium.

      1. Add specified amount of distilled or deionized water to the contents of the premixed package.
      2. Add supplements, if recommended.

PERFORMANCE GUIDE: (cont.)

- B. Follow a tissue culture medium recipe to produce the culture medium:
  1. Make up needed stock solutions.
  2. Place volumetric flasks on magnetic-hot plate-stirrers.
  3. Fill volumetric flask 1/2 full with distilled water.
  4. Add proper aliquots of stock solutions.
  5. Add sucrose.
  6. Bring up to volume with distilled water.

4. Test pH of the culture medium.
5. Adjust pH of the culture medium.
6. Add specified amount of agar or other solidifying agent if used.
7. Heat culture medium while stirring to dissolve the solidifying agent.

   NOTE: Culture medium must be heated almost to the boiling point, approximately 98°C (208°F), to dissolve the solidifying agent.

   CAUTION: Do not leave culture medium unattended during heating process. There is only a slight difference between the temperature at which the solidifying agent goes into solution and the temperature at which it boils over.
8. Dispense approximately 15 ml of medium into culture vessel and cap.

   NOTE: Do not spill medium on sides of culture vessels.
9. Sterilize culture vessels in an autoclave for 20 minutes at 121° C or in a pressure cooker for 20 minutes at 15 pounds of pressure.

   CAUTION: Follow manufacturer's operating instructions and safety precautions.

   CAUTION: If using a pressure cooker, wait until pressure registers zero on pressure indicator before opening pressure cooker.
10. Remove culture vessels after processing and place in racks.
11. Label and store the sterilized vessels of medium in a cool, clean place.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Prepare tissue culture growing medium.

ENABLER

1. Recall hazard of impurities in undistilled water.
2. Recall disinfestation solution and disinfestation equipment safety.
3. Recall units of measurement. (volume/weight)
4. Read sterilization equipment operating instructions.
5. Label tissue culture medium vessels.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare tissue culture growing medium.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Listed the estimated quantity of culture medium needed.	________	________
2. Rinsed all equipment and containers with distilled/deionized water before using.	________	________
Premixed package of culture medium:		
3. Added specified amount of distilled or deionized water to the contents of the premixed package.	________	________
4. Added supplements, if recommended.	________	________
Tissue culture medium recipe:		
5. Made up needed stock solutions.	________	________
6. Placed volumetric flasks on magnetic-hot plate-stirrers.	________	________
7. Filled volumetric flask 1/2 full with distilled water.	________	________

PERFORMANCE DETERMINANTS (cont.)	YES	NO
8. Added proper aliquots of stock solutions.	______	______
9. Added sucrose.	______	______
10. Added distilled water until recommended volume was reached.	______	______
11. Tested pH of the culture medium.	______	______
12. Adjusted pH of the culture medium.	______	______
13. Added specified amount of agar or other solidifying agent.	______	______
14. Heated culture medium while stirring.	______	______
15. Dispensed approximately 15 ml of medium into culture vessel and capped the vessel.	______	______
16. Sterilized culture vessels.	______	______
17. Labeled and stored the sterilized vessels of medium.	______	______

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 74

TASK: Prepare explants for Stage I.

STANDARD OF PERFORMANCE OF TASK:

The explant must be disinfested, rinsed, and placed into the sterile medium in culture vessels and capped without contamination. All disinfesting processes and transfer operations must be performed within a laminar flow hood. The culture vessels must be labeled.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.
Plants From Test Tubes An Introduction to Micropropagation.
Introduction to In Vitro Propagation.

CONDITIONS FOR PERFORMANCE OF TASK:

Labels
Scalpel
Forceps
Stock plant
Waste basket
Disinfestant
Latex gloves
Distilled water
Bacti-cinerator
Laminar flow hood
Culture growing room
Sterile paper toweling
Sterile medium in vessels
Racks for culture vessels

ENABLING OBJECTIVES:

1. Recall hazard of air born microorganisms.
2. Recall disinfestation solution and disinfestation equipment safety.
3. Recall units of measurement (size of explant).
4. Read laminar flow hood operating instructions.
5. Label culture vessels.
6. Write or print information in propagation records.

***RESOURCES:**

1. Wetherell, D. (1982). Introduction to in vitro propagation. Wayne, NJ: Avery.
2. Kyte, L. (1983). Plants from test vessels an introduction to micropropagation. Portland, OR: Timber Press.
3. Evans, D., Sharp, W., Ammirato, P., & Yamada, Y. (Eds.). (1983). Handbook of plant cell culture (Vols. 1-4). New York, NY: Macmillan.
4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
5. Laminar flow hood operating instructions.
6. Propagation records.
7. Checklist - Preparing explants for stage I.

TEACHING ACTIVITIES:

1. Show examples of explants that have recently been placed into culture vessels.
2. Outline procedures used to prepare explants for stage I.
3. Present lecture on selection of stock plants. (* 1,2,3 & 4)
4. Present lecture on selection of plant tissue from stock plants. (* 1,2,3 & 4)
5. Demonstrate how to prepare a disinfestant solution for the surface sterilization of the plant tissue. (* 1,2,3 & 4)
6. Demonstrate how to turn on the laminar flow hood fan. (* 5)
7. Assign students to mix a disinfestant solution and disinfest the surface of the laminar flow hood.
8. Demonstrate how to turn on the Bacti-cinerator.
9. Assign students to move the tools and vessels to the laminar flow hood and spray the tools and vessels with a disinfestant solution.
10. Demonstrate how to disinfest the plant material to be used as the explant source. (* 1,2 & 3)
11. Present lecture on plant parts used as explants and the size of the explants. (* 1,2 & 3)
12. Demonstrate how to remove plant parts to be used as the explants. (* 1,2 & 3)
13. Demonstrate how to disinfest and rinse the explant. (* 1,2 & 3)
14. Show examples of explants with varying degrees of damaged tissue (damage caused by disinfestant).
15. Question students on the way they would trim the damaged tissue from individual examples of disinfested explants.

TEACHING ACTIVITIES: (cont.)

16. Question students on hand tool, disinfestant solution and disinfestant equipment safety.
17. Demonstrate how to place the explant in a sterilized culture vessel and cap the culture vessel. (* 1,2 & 3)
18. Assign students to label the culture vessel.
19. Demonstrate how to record the stage I data in the propagation records.
20. Question each student on the step-by-step disinfestation procedures.
21. Question each student on disinfestant solution, disinfestant equipment and hand tool safety.
22. Assign each student a plant species from which to prepare explants for stage I. (* 6)

CRITERION-REFERENCED MEASURE:

The student must select the plant material to be used as an explant source, perform all required disinfestation procedures, prepare and place the explant, label the culture vessels and record the stage I data. The explant source plant material must be the best available (test administrator's judgment), the explant must be disinfested, rinsed, and placed into the sterile medium in culture vessels and capped without contamination. All disinfesting processes and transfer operations must be performed within a laminar flow hood. The label and the propagation records must be complete and legible.

PERFORMANCE GUIDE:

1. Select plant species and explant type needed.
2. Select a stock plant that has been grown in a greenhouse or indoors under light.
3. Turn on fan in laminar flow hood.
4. Disinfest the surface on the laminar flow hood.
   NOTE: A 10% chlorine bleach solution is generally used as a disinfestant.
5. Turn on the Bacti-cinerator.
6. Place all tools and vessels in the laminar flow hood.
7. Spray all vessels thoroughly with disinfestant.
8. Remove the plant parts from stock plant that are to be used as explant sources.
   NOTE: Remove a larger piece of plant tissue from stock plant than amount actually needed.

PERFORMANCE GUIDE: (cont.)

9. Prepare disinfestant plus wetting agent for the surface sterilization of plant tissue.
   NOTE: A 10% chlorine bleach solution is generally used to surface sterilize plant tissue. One ml of Tween 20 (Polyoxethylene sorbitan monolaurate) per liter of bleach solution is generally added as a wetting agent. Some plant tissue may require an alcohol treatment.
   CAUTION: The chlorine bleach solution must not be made up ahead of time because the chlorine evaporates.
10. Disinfest explant:
    CAUTION: The process of disinfesting the explant and the placement of explant into the culture vessels should be performed within a laminar flow hood. All movements should be performed away from one's body to prevent the spread of fungal spores, bacteria, and other microorganisms.
    A. Wear latex gloves that are wet with disinfestant.
       CAUTION: Gloves can be disinfested in a 10% bleach solution or other recommended disinfestant. Gloves must be sprayed with disinfestant often and kept wet with disinfestant at all times.
    B. Submerge explant in disinfestant recommended for particular plant species for approximately 10-20 minutes.
       NOTE: A 10% chlorine bleach solution is generally used to surface sterilize plant tissue. One ml of Tween 20 (Polyoxethylene sorbitan monolaurate) per liter of bleach solution is generally added as a wetting agent. Some plant tissue may require an alcohol treatment.
11. Rinse explant thoroughly with sterile distilled water for approximately 5 minutes.
12. Repeat rinsing process two more times.
13. Remove explant from rinse water and place on sterile paper toweling.
    NOTE: All instruments that are used to handle explants should be sterilized in the Bacti-cinerator for 5-10 seconds.

PERFORMANCE GUIDE: (cont.)

14. Trim edges of explant to remove tissue damaged by disinfestant with a sterile scalpel.
    NOTE: The scalpel needs to be sterilized between each explant that it is used on.
15. Place explant right side up on sterilized growing medium in sterilized culture vessel.
16. Cap the culture vessels.
17. Label the culture vessels.
18. Transfer labeled culture vessels from within the laminar flow hood to a culture growing room.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Prepare explants for Stage I.

ENABLER

1. Recall hazard of air born microorganisms.
2. Recall disinfestation solution and disinfestation equipment safety.
3. Recall units of measurement (size of explant).
4. Read laminar flow hood operating instructions.
5. Label culture vessels.
6. Write or print information in propagation records.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare explants for Stage I.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected a stock plant.	______	______
2.	Turned on fan in laminar flow hood.	______	______
3.	Disinfested the surface on the laminar flow hood.	______	______
4.	Turned on the Bacti-cinerator.	______	______
5.	Placed all tools and vessels in the laminar flow hood.	______	______
6.	Sprayed all vessels thoroughly with disinfestant.	______	______
7.	Removed the plant parts from stock plant that are to be used as explant sources.	______	______
8.	Removed a larger piece of plant tissue from stock plant than amount actually needed.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
9. Prepared disinfestant plus wetting agent for the surface sterilization of plant tissue.		
10. Wore latex gloves that were wet with disinfestant.		
11. Submerged explant in disinfestant.		
12. Rinsed explant thoroughly.		
13. Removed explant from rinse water and placed it on sterile paper toweling.		
14. Sterilized all instruments used to handle explants in the Bacti-cinerator.		
15. Trimmed edges of explant.		
16. Placed explant right side up on sterilized growing medium in sterilized culture vessel.		
17. Capped the culture vessels.		
18. Labeled the culture vessels.		
19. Transferred labeled culture vessels from within the laminar flow hood to a culture growing room.		

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 75

TASK: Transfer shoot cultures.

STANDARD OF PERFORMANCE OF TASK:

Shoot cultures must be inspected, divided, trimmed and transferred into specified sterile medium in vessels and capped without contamination. All operations must be performed under a laminar flow hood. The culture vessels must be labeled and transferred to a culture room.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.
Plants From Test Tubes An Introduction to Micropropagation.
Introduction to In Vitro Propagation.

CONDITIONS FOR PERFORMANCE OF TASK:

Knife
Labels
Scalpel
Spatula
Forceps
Waste basket
Vessel racks
Disinfestant
Latex gloves
Culture vessels
Bacti-cinerator
Distilled water
Laminar flow hood
Container for caps
Culture growing room
Sterile paper toweling
Sterile medium in vessels

ENABLING OBJECTIVES:

1. Recall hazard of air born microorganisms.
2. Recall disinfestation solution and disinfestation equipment safety.
3. Recall units of measurement (size of transferred microshoots).

ENABLING OBJECTIVES: (cont.)

4. Read laminar flow hood operating instructions.
5. Label culture vessels.
6. Write or print information to propagation records.

***RESOURCES:**

1. Wetherell, D. (1982). Introduction to in vitro propagation. Wayne, NJ: Avery.
2. Kyte, L. (1983). Plants from test tubes an introduction to micropropagation. Portland, OR: Timber Press.
3. Evans, D., Sharp, W., Ammirato, P., & Yamada, Y. (Eds.). (1983). Handbook of plant cell culture (Vols. 1-4). New York, NY: Macmillan.
4. Laminar flow hood operating instructions.
5. Propagation records.
6. Checklist - Transferring shoot cultures.

TEACHING ACTIVITIES:

1. Show examples of shoot cultures that are ready for transfer.
2. Present lecture on how to recognize and handle contaminated cultures.
3. Outline procedures used to transfer shoot cultures.
4. Present lecture on selection of shoot cultures from which to remove microshoots.
5. Present lecture on removal of dead and brown tissue from shoot cultures.
6. Demonstrate how to turn on the laminar flow hood fan. (* 4)
7. Assign students to mix a disinfestant solution and disinfest the surface of the laminar flow hood.
8. Demonstrate how to turn on the Bacti-cinerator.
9. Assign students to move the vessels to the laminar flow hood and spray the vessels with a disinfestant solution.
10. Present lecture on the size of the plant parts that are transferred.
11. Demonstrate how to sterilize the tools use during the transfer process.
12. Show examples of cultures that display varying degrees of growth, development, brown material and/or contamination.
13. Question students on the way they would divide and/or trim dead or brown tissue from shoot cultures.
14. Question students on hand tool, disinfestant solution and disinfestant equipment safety.

TEACHING ACTIVITIES: (cont.)

15. Demonstrate how to divide and/or trim dead or brown tissue from shoot cultures and make transfers to sterilized vessels. (* 1,2 & 3)
16. Assign students to label the transferred plantlet.
17. Demonstrate how to record the transfer data. (* 5)
18. Question each student on the step-by-step disinfestation procedures.
19. Question each student on disinfestant solution, disinfestant equipment and hand tool safety.
20. Assign each student a number of culture vessels from which to transfer plantlets. (* 6)

CRITERION-REFERENCED MEASURE:

The student must perform all required disinfestation procedures, prepare the plantlets for transfer, place the plantlets in culture vessels, label the culture vessels and record the transfer data. Plantlets from culture vessels must be inspected, divided, trimmed and transferred into specified sterile medium in vessels and capped without contamination. All operations must be performed under a laminar flow hood. The label and propagation records must be complete and legible.

PERFORMANCE GUIDE:

1. Identify plantlets that require transferring to another vessel.
2. Obtain sterilized vessels that contain the specified sterilized growing medium.
   NOTE: The formulation of the growing medium varies with particular plant species, stage of growth, and objective of transfer.
3. Turn on fan in laminar flow hood.
4. Disinfest the surface on the laminar flow hood.
   NOTE: A 10% chlorine bleach solution is generally used as a disinfestant.
5. Turn on the Bacti-cinerator.
6. Disinfest all tools, sterilized vessels, and plantlets and place them within the laminar flow hood.
7. Wear latex gloves that are wet with disinfestant.
   CAUTION: Gloves can be disinfested in a bleach solution or other recommended disinfestant. Gloves must be sprayed with disinfestant often and kept wet with disinfestant at all times.

PERFORMANCE GUIDE: (cont.)

8. Sterilize scalpel, knife, forceps, spatula and any other tools that will be used during the transfer process in the Bacti-cinerator for 5 to 10 seconds.
   CAUTION: Tools must be sterilized between each plantlet and whenever they have become contaminated.
9. Inspect the plantlets for contamination or other undesirable characteristics.
10. Check the identification label of the culture vessel.
11. Remove the cap from culture vessel.
12. Remove the plant culture from the vessel with sterile forceps and place on sterile paper toweling.
    CAUTION: The process of transferring plantlets should be performed within a laminar flow hood. All movements should be performed away from one's body to prevent the spread of mold spores, bacteria, and other microorganisms.
13. Replace cap and place dirty vessel into a culture vessel rack.
14. Divide culture using sterilized scalpel or knife and forceps.
15. Trim away any dead or brown material.
16. Sterilize the forceps.
17. Remove cap from vessel of fresh, sterilized medium.
    CAUTION: Leave vessels uncovered only for as short a time as necessary.
18. Place a plantlet in/on the sterilized medium using the sterilized forceps.
    NOTE: Plantlet must make good contact with the medium.
19. Replace cap on vessel.
20. Set vessel in a holding rack.
21. Sterilize all tools between transfers.
22. Repeat transferring process with the other plantlets from the same explant.
23. Label the vessels.
24. Record transfer data in plant propagation production records.
25. Move labeled culture vessels from within laminar flow hood to a culture growing room.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Transfer shoot cultures.

ENABLER

1. Recall hazard of air born microorganisms.
2. Recall disinfestation solution and disinfestation equipment safety.
3. Recall units of measurement (size of transferred plantlets).
4. Read laminar flow hood operating instructions.
5. Label culture vessels.
6. Write or print information to propagation records.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to transfer shoot cultures.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified plantlets that require transferring to another vessel.	______	______
2. Identified sterilized vessels that contain the specified sterilized growing medium.	______	______
3. Turned on fan in laminar flow hood.	______	______
4. Disinfested the surface on the laminar flow hood.	______	______
5. Turned on the Bacti-cinerator.	______	______
6. Placed all tools, sterilized vessels, and plantlets within the laminar flow hood.	______	______
7. Sprayed all vessels thoroughly with disinfestant.	______	______
8. Wore latex gloves that were wet with disinfestant.	______	______

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
9.	Sterilized scalpel, knife, forceps, spatula and any other tools.		
10.	Inspected the plantlets for contamination or other undesirable characteristics.		
11.	Checked the identification label of the culture vessel.		
12.	Removed the cap from culture vessel and dropped it into a container on the floor.		
13.	Removed the plant culture from the vessel with sterile forceps and placed sterile paper toweling.		
14.	Placed dirty vessel into a culture vessel rack.		
15.	Divided culture using sterilized scalpel or knife and forceps.		
16.	Trimmed away any dead or brown material.		
17.	Sterilized the forceps.		
18.	Removed cap from vessel of fresh, sterilized medium.		
19.	Placed a plantlet in/on the sterilized medium using the sterilized forceps.		
20.	Replaced cap on vessel.		
21.	Set vessel in a holding rack.		
22.	Sterilized all tools between transfers.		
23.	Repeated transferring process with the other plantlets from the same explant.		
24.	Labeled the vessels.		
25.	Recorded transfer data in plant propagation production records.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
26. Moved labeled culture vessels from under laminar flow hood to a culture growing room.	________	________

DUTY: PROPAGATING HORTICULTURAL PLANTS

PERFORMANCE OBJECTIVE NO. 76

TASK: Lay sod.

STANDARD OF PERFORMANCE OF TASK:

Sod must be laid on a prepared and moistened sodbed without long seams or gaps between rolls. Sod strips must be flattened to the sodbed using a roller. The sod must be irrigated immediately, until moisture reaches a depth of 2 to 3 inches.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Illinois Lawn Care and Establishment.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Sodbed
Roller
Rolls of sod

ENABLING OBJECTIVES:

1. Recognize a prepared sodbed.
2. Evaluate soil moisture content.
3. Irrigate sod.
4. Lift, carry and lower a roll of sod.

***RESOURCES:**

1. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
2. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Champaign-Urbana.
3. Sprague, H. (1982). Turf management handbook. Fort Worth, TX: Branch-Smith Publishing.
4. Turgeon, A. (1980). Turf grass management. Reston, VA: Reston.
5. Daniel, W., & Freeborg, R. (1980). Turf managers' handbook. Cleveland, OH: Harvest.
6. Checklist - Laying sod.

TEACHING ACTIVITIES:

1. Outline procedures used to lay sod.
2. Discuss the importance of sodbed preparation.
3. Show an example of a prepared sodbed.
4. Present lecture on placement of first roll of sod. (* 1,2,3,4 & 5)
5. Present lecture on orientation of sod rolls on slopes. (* 1,2,3,4 & 5)
6. Assign students to irrigate the prepared sodbed.
7. Demonstrate how to lift, carry and lower a roll of sod.
8. Question students regarding the logical location to place the first roll of sod.
9. Demonstrate how to place the first roll of sod.
10. Demonstrate how to place adjoining rolls of sod and how to fit the edges of the rolls tightly.
11. Demonstrate how to flatten the newly laid sod using a roller.
12. Monitor students as they practice placing adjoining rolls of sod.
13. Monitor students as they practice flattening the newly laid sod with a roller.
14. Demonstrate how to check the moisture level of the soil under newly laid sod.
15. Assign each student an area of prepared sodbed on which to lay sod. (* 6)

CRITERION-REFERENCED MEASURE:

The student must irrigate the sodbed if needed, place several rolls of sod and flatten the newly placed sod. The strips of sod must be placed so that they will stay on a slope (length perpendicular to slope and/or staked), fit tightly together (less than 1/4 inch gap between strips), do not form long seams (seams formed by ends of rolls not longer than width of roll), be in contact with sodbed (sod adheres to sodbed) and be thoroughly watered (water penetrates top 2-3 inches of sodbed).

PERFORMANCE GUIDE:

1. Inspect sodbed to insure grading, cultivation, and fertilizer/amendment operations have been completed.
2. Irrigate sodbed, if needed.
3. Unroll first roll of sod on sodbed.
   CAUTION: Avoid stretching the sod to prevent shrinkage.

PERFORMANCE GUIDE: (cont.)

4. Place adjoining rolls of sod so edges fit tightly together.
5. Stagger the ends of the laid rolls of sod to prevent a long seam.
6. Roll to flatten newly laid sod strips to the sod bed.
7. Irrigate thoroughly until water penetrates the sod strips and moistens the top two to three inches of sodbed.
8. Check sodbed moisture level frequently until sod is established by raising corner of sod strips and observing moisture depth.
9. Irrigate when needed.

CHECKLIST

DUTY Propagating Horticultural Plants

TASK Lay sod.

ENABLER

1. Recognize a prepared sodbed.
2. Evaluate soil moisture content.
3. Irrigate sod.
4. Lift, carry and lower a roll of sod.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to lay sod on a prepared sodbed.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Checked sodbed for adequate moisture.	______	______
2.	Irrigated sodbed if needed.	______	______
3.	Placed first roll of sod in logical location.	______	______
4.	Placed first roll of sod so length is perpendicular to the slope.	______	______
5.	Placed adjoining rolls of sod so edges fit tightly together.	______	______
6.	Placed adjoining rolls of sod so that the seams formed by the ends of the sod roll are no longer than the width of a roll of sod.	______	______
7.	Placed rolls of sod so that there were no gaps larger than 1/4 inch.	______	______
8.	Flattened newly placed sod using a roller.	______	______
9.	Secured rolls of sod placed on slopes with stakes if needed.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 77

TASK: Irrigate field grown plants.

STANDARD OF PERFORMANCE OF TASK:

Field grown plants must be irrigated to depth of 1/2-2 inches. Irrigation rate must be less than soil's capacity to absorb water.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Irrigation system
Plants
Moisture meter

ENABLING OBJECTIVES:

1. Measure time.
2. Set up irrigation equipment.
3. Recall a plant's ability to absorb water from roots and foliage.

***RESOURCES:**

1. Israelsen, O., & Hansen, V. (1980). Irrigation principles and practices. Fort Atkinson, WI: Nasco.
2. Sarsfield, A. (1982). The abc's of lawn sprinkler systems. LaFayette, CA: Irrigation Technical Services Publications Division.
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Checklist - Irrigating field grown plants.

TEACHING ACTIVITIES:

1. Discuss the importance of maintaining adequate soil moisture level.
2. Outline procedures used to irrigate field grown plants. (* 1,2 & 3)
3. Show examples of dry soil, moist soil and saturated soil.

TEACHING ACTIVITIES: (cont.)

4. Show examples of wilting and turgid plants.
5. Present lecture on causes of wilting other than low soil moisture.
6. Demonstrate how to use a moisture meter.
7. List methods of irrigation. (* 1,2 & 3)
8. Show examples of irrigation systems.
9. List factors to consider when determining method of irrigation. (* 1,2 & 3)
10. Demonstrate how to inspect an irrigation system.
11. List factors to consider when determining amount of water to be applied.
12. Demonstrate how to determine maximum rate that water can be applied (soils absorption capacity).
13. Demonstrate how to measure and adjust the application rate of irrigation system.
14. Present lecture on estimating the length of the irrigation time based on application rate.
15. Question students on their estimation of the length of irrigation time.
16. Demonstrate how to regulate the water output of the irrigation system.
17. Demonstrate how to check depth of penetration of water.
18. Assign each student an area of field grown plants to irrigate. (* 4)

CRITERION-REFERENCED MEASURE:

The student must determine the amount of water to be applied, determine the rate that the water should be applied, estimate the length of irrigation time and regulate the application rate and the amount of water applied. The water applied must be enough to penetrate the soil to a depth of 1/2-2 inches without exceeding the soil's capacity to absorb the water at any time (no puddles or run-off).

PERFORMANCE GUIDE:

1. Identify when plants require irrigation:
   A. Feel the soil.
   B. Use a moisture meter.
   C. Look at the color of the soil.
   D. Look at plants for wilting.

PERFORMANCE GUIDE: (cont.)

2. Identify method of irrigation:
   - A. Overhead sprinkling system.
   - B. Surface irrigation system.
   - C. Subirrigation system.
   - D. Trickle irrigation system.
   - E. Manual.
3. Estimate the length of irrigation time:
   - A. Consider method of irrigation used.
   - B. Consider time of day water is applied.
   - C. Consider weather conditions.
   - D. Consider rate of application:
     1. Determine soil absorptive capacity.
        NOTE: Water should not be applied faster than soil's capacity to absorb water.
     2. Determine the maximum gallons per minute that can be applied with particular irrigation system.
   - E. Existing soil moisture.
4. Apply required amount of water to plants, generally equivalent to 1/2-2 inches of rainfall.
   CAUTION: Follow manufacturer's recommendations, when using an automated or semi-automated irrigation system.

CHECKLIST

DUTY Growing Plants

TASK Irrigate field grown plants.

ENABLER

1. Measure time.
2. Measure distance in inches.
3. Recall factors to consider when determining method of irrigation.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to irrigate field grown plants.

PERFORMANCE DETERMINANTS	YES	NO
1. Recorded amount of water to be applied.	______	______
2. Recorded soil's absorption capacity.	______	______
3. Recorded application rate of irrigation system.	______	______
4. Listed the estimated length of irrigation time.	______	______
5. Inspected irrigation system.	______	______
6. Regulated application rate of irrigation system.	______	______
7. Avoided flooding the field grown plants.	______	______
8. Recorded depth of water penetration in inches.	______	______
9. Stopped irrigating when water penetrated soil 2 inches.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 78

TASK: Irrigate container grown plants.

STANDARD OF PERFORMANCE OF TASK:

Water must be applied until media is moistened and water drains from the drainage holes in the container.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Irrigation system
Container grown plants
Moisture meter

ENABLING OBJECTIVES:

1. Measure time, distance and volume.
2. Set up irrigation equipment.
3. Recall a plant's ability to absorb water from roots and foliage.

***RESOURCES:**

1. Sunset Books. (1984). Container gardening. Menlo Park, CA: Lane Publishing Co.
2. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.
3. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
4. Israelsen, O., & Hansen, V. (1980). Irrigation principles and practices. Fort Atkinson, WI: Nasco.
5. Checklist - Irrigating container grown plants.

TEACHING ACTIVITIES:

1. Discuss the importance of maintaining adequate soil moisture levels. (* 1,2 & 3)
2. Outline the procedures used to irrigate container grown plants. (* 1,2,3,4 & 5)

TEACHING ACTIVITIES: (cont.)

3. Show examples of dry soil, moist soil and saturated soil.
4. Instruct students to compare the weight of a potted plant that is wet to a potted plant that is dry.
5. Show examples of wilted and turgid plants.
6. Present lecture on causes of wilting other than low soil moisture.
7. Present lecture on avoiding salt buildup in closed confines.
8. Demonstrate how to use a moisture meter.
9. List methods of irrigation. (* 1,2,3 & 4)
10. Show examples of irrigation systems.
11. List factors to consider when determining method of irrigation.
12. Demonstrate how to inspect an irrigation system.
13. List factors to consider when determining amount of water to be applied.
14. Demonstrate how to determine maximum rate that water can be applied (soils absorption capacity).
15. Demonstrate how to measure and adjust the application rate of irrigation system.
16. Present lecture on estimating the length of the irrigation time based on application rate.
17. Demonstrate how to regulate the water output of the irrigation system.
18. Assign each student a plot of container grown plants to irrigate. (* 5)

CRITERION-REFERENCED MEASURE:

The student must determine the amount of water to be applied, determine the rate that the water should be applied, estimate the length of irrigation time and regulate the application rate and the amount of water applied. The water applied must be enough to cause water to drain from the drainage holes in the container without water spilling over the rim of the container.

PERFORMANCE GUIDE:

1. Identify when plant requires irrigation:
   - A. Feel the soil.
   - B. Use a moisture meter.
   - C. Look at the color of the soil.
   - D. Feel the weight of the container.
   - E. Look at plants for wilting.
2. Identify method of irrigation:
   - A. Overhead sprinkling system.
   - B. Capillary irrigation system.
   - C. Microtube system.
   - D. Manual.
3. Estimate length of irrigation time, considering:
   - A. Method of irrigation used.
   - B. Time of day of water application.
   - C. Weather conditions.
   - D. Size of container.
   - E. Rate of application:
     1. Media absorptive capacity.
     2. Method of irrigation.

        NOTE: Maximum application rate is determined by the gallons per minute that can be applied with particular method of irrigation and the medium's capacity to absorb water.
4. Apply water to plants:
   - A. All medium in container should be moistened.
   - B. Some water must drain from drainage holes in containers.

     CAUTION: Follow manufacturer's recommendations when using an automated or semiautomated irrigation system.

CHECKLIST

DUTY Growing Plants

TASK Irrigate container grown plants.

ENABLER

1. Measure time, distance and volume.
2. Set up irrigation equipment.
3. Recall a plant's ability to absorb water from roots and foliage.

STUDENT'S NAME ______________________________ **DATE** __________

EVALUATOR'S NAME ____________________________ **COURSE** ________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to irrigate container grown plants.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Recorded amount of water to be applied.	______	______
2.	Recorded application rate of irrigation system.	______	______
3.	Recorded the estimated length of irrigation time.	______	______
4.	Regulated application rate of irrigation system.	______	______
5.	Avoided water spilling over the rim of the container.	______	______
6.	Avoided washing soil from the container grown plants.	______	______
7.	Stopped irrigating when water drained from the drainage holes in the container.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 79

TASK: Prune plants.

STANDARD OF PERFORMANCE OF TASK:

All pruning on small branches must be made 1/4 inch from bud with growth guided in desired direction. All large branches must be cut at the collar. Chemical pruning agents must be applied, following manufacturer's recommendations.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Tree Maintenance.
America's Garden Book.
Horticultural Science.

CONDITIONS FOR PERFORMANCE OF TASK:

Shears
Plants
Ladder
Loppers
Pruning saw
Pole pruner
Disinfestant
Growth regulator (pruning agent)

ENABLING OBJECTIVES:

1. Recognize dead, diseased, injured or broken branches.
2. Recall hand tool safety.
3. Recall horticultural chemical safety.

***RESOURCES:**

1. Sunset Books. (1983). Pruning handbook. Menlo Park, CA: Lane Publishing Co.
2. Pirone, P. (1972). Tree maintenance (5th ed.). New York, NY: Oxford University Press.
3. Ortho Books. (1978). All about pruning. San Francisco, CA: Author.
4. Chase, A. (1987). Compendium of ornamental foliage plant diseases. Chicago, IL: American Nurseryman Publishing Co.

***RESOURCES:** (cont.)

5. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
6. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
7. Hydraulic or pneumatic pruning equipment operating instructions.
8. Checklist - Pruning plants.

TEACHING ACTIVITIES:

1. List reasons why plants are pruned. (* 1,2 & 3)
2. List plants that are pruned for specific reasons.
3. Present lecture on the time of year to prune the listed plants. (* 1,2 & 3)
4. Present lecture on removing injured, dead or diseased parts. (* 1,2,3,4,5 & 6)
5. Discuss the importance of disinfesting tools while pruning diseased plant parts.
6. Present lecture on pruning to increase flowers and fruit. (* 1,2 & 3)
7. Present lecture on pruning to control plant growth. (* 1,2 & 3)
8. Present lecture on pruning to improve the appearance of the plant. (* 1,2 & 3)
9. Present lecture on pruning to rejuvenate old plants. (* 1,2 & 3)
10. Present lecture on chemical pruning agents.
11. Show examples of pruning equipment and tools.
12. Present lecture on pruning tool and equipment safety. (* 7)
13. Show examples of plants that need to be pruned.
14. Demonstrate how to prune a plant. (* 1,2,3,4 & 5)
15. Question students on pruning equipment and tool safety.
16. Monitor students as they practice pruning plants.
17. Assign students to dispose of the plant material that has been removed from the plant.
18. Assign each student a plant to prune. (* 8)

CRITERION-REFERENCED MEASURE:

The student must determine and record the best time of year to prune the plant, remove all dead and diseased parts and prune the plant to achieve the desire objective (mechanically or chemically.) All

CRITERION-REFERENCED MEASURE: (cont.)

cuts on small branches must be made 1/4 inch from a bud which will grow in the desired direction, all large branches must be cut at the collar, and chemical pruning agents must be applied according to the manufacturer's recommendations.

PERFORMANCE GUIDE:

1. Select objective of pruning:
    - A. Remove injured, dead or diseased parts:
        1. Cut broken branches back to the next lower crotch, main limb, or growing point.
        2. Remove diseased branches/stems at least 3 inches below the point of visible infection.
        3. Disinfest tools frequently when pruning diseased plant parts.
    - B. Increase the quality of flowers and fruits:
        1. Consider the flowering and/or fruiting habit of particular species.
        2. Thin limbs to increase light penetration.
    - C. Control the growth of plants:
        1. Thin limbs to reduce the crowding of inner stems.
        2. Head back new growth to uniform lengths.
        3. Alter the direction of branch/stem growth.
    - D. Improve appearance of plant:
        1. Remove limbs growing toward the plant center.
        2. Remove crossing limbs.
        3. Remove vertical growth, water sprouts, and suckers.
    - E. Rejuvenate old plants:
        1. Cut all plant stems of specified shrubs to 4-6 inches above the ground or remove the oldest 1/3 of the plant stems of specified plants.
2. Identify method of pruning:
    - A. Prune with pruning equipment/tools:
        1. Identify recommended season to prune particular plant species.

           NOTE: As a general rule, flowering shrubs are pruned after they flower, evergreen shrubs are pruned after new spring growth, and deciduous trees are pruned while dormant.

PERFORMANCE GUIDE: (cont.)

2. Make a clean cut on small branches at angle 1/4 inch above a bud:
    a. Cut above an outside bud to direct growth outward.
    b. Cut above an inside bud to direct growth inward.
    NOTE: On species with buds arranged opposite of each other, one bud may be removed to direct growth.
3. Make a clean final cut on large branches at the collar.
    a. Cut halfway through the underside of the branch, approximately 1 foot from main trunk, when making the first cut.
    b. Make second cut from above, cutting several inches beyond initial cut.
    c. Remove remaining stub.

B. Prune using chemicals:
1. Identify recommended season to prune particular plant species.
    NOTE: Flowering shrubs are generally pruned after they flower. Evergreen shrubs are generally pruned after new spring growth. Deciduous trees are generally pruned while dormant.
2. Apply plant growth regulator that can be used as a chemical pruning agent.
3. Follow manufacturer's recommendations and safety precautions when applying chemical pruning agent.

3. Dispose of plant material that has been removed from plant.

CHECKLIST

DUTY Growing Plants

TASK Prune plants.

ENABLER

1. Recognize dead or diseased branches.
2. Recall horticultural chemical safety.
3. Recall pruning tool and equipment safety.

STUDENT'S NAME______________________________ **DATE**____________

EVALUATOR'S NAME____________________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prune plants.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified the best time of year to prune the plant(s).	______	______
2.	Cut broken branches back to the next lower crotch, main limb, or growing point.	______	______
3.	Removed diseased branches/stems at least 3 inches below the point of visible infection.	______	______
4.	Disinfested tools frequently.	______	______
5.	Thinned limbs to increase light penetration.	______	______
6.	Thinned limbs to reduce the crowding of inner stems.	______	______
7.	Headed back new growth to uniform lengths.	______	______
8.	Altered the direction of branch/stem growth.	______	______

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
9.	Removed limbs growing toward the plant center.	________	________
10.	Removed crossing limbs.	________	________
11.	Removed vertical growth, water sprouts, and suckers.	________	________
12.	Cut all plant stems of specified shrubs to 4-6 inches above the ground.	________	________
13.	Removed the oldest 1/3 of the plant stems to the ground each year.	________	________
14.	Cut above an outside bud to direct growth outward.	________	________
15.	Cut above an inside bud to direct growth inward.	________	________
16.	Cut halfway through the underside of large branches, approximately 1 foot from main trunk, when making the first cut.	________	________
17.	Made second cut from above, cutting several inches beyond initial cut.	________	________
18.	Removed remaining stub at the collar.	________	________
19.	Applied plant growth regulator that can be used as a chemical pruning agent.	________	________
20.	Followed manufacturer's recommendations and safety precautions when applying chemical pruning agent.	________	________
21.	Disposed of plant material that had been removed from plant.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 80

TASK: Shear plants.

STANDARD OF PERFORMANCE OF TASK:

The plant's shape must be fashioned so plant's top growth does not shade the rest of the plant.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Ladder
Loppers
Pruning shears
Hedge trimmers
Plant (requiring shearing)

ENABLING OBJECTIVES:

1. Recall hedge trimmer safety.
2. Identify plant's old growth and new growth.
3. Determine if plant species will readily produce new growth on old wood.

***RESOURCES:**

1. Sunset Books. (1983). Pruning handbook. Menlo Park, CA: Lane Publishing Co.
2. Pirone, P. (1972). Tree maintenance (5th ed.). New York, NY: Oxford University Press.
3. Krussman, G. (1985). Manual of cultivated broad leaved trees and shrubs (Vol. 3). Fort Worth, TX: Branch-Smith Publishing.
4. Rehder, A. (1986). Manual of cultivated trees and shrubs hardy in North America. Chicago, IL: American Nurseryman Publishing Co.
5. Dirr, M. (1983). Manual of woody landscape plants: Their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.

***RESOURCES:** (cont.)

6. Dirr, M. (1978). Photographic manual of woody landscape plants. Champaign, IL: Stipes Publishing Co.
7. Symonds, G. (1963). The shrub identification book. Fort Atkinson, WI: Nasco.
8. Checklist - Shearing plants.

TEACHING ACTIVITIES:

1. Present lecture on the positive and negative aspects of shearing plants. (* 1 & 2)
2. Show several examples of plant shapes that allow light to reach the foliage at the top, middle and bottom of the plant. (* 1,2,6 & 7)
3. Present lecture on plant growth and development at bud break and onset of dormancy. (* 1 & 2)
4. List factors to consider when determining if shearing the plant will cause excessive damage to the plant. (* 1,2,3,4 & 5)
5. Show several examples of tools used for shearing plants.
6. Question students on hedge trimmer safety.
7. Question students on what pattern (begin and end cutting where?) they would use when shaping a plant.
8. Demonstrate how to determine where old wood stops and new wood starts.
9. Monitor students as they practice shearing plants.
10. Demonstrate how to operate a hedge trimmer.
11. Demonstrate how to dispose of clippings.
12. Assign each student a plant to shear. (* 8)

CRITERION-REFERENCED MEASURE:

The student must determine if the shearing can be performed without excessive damage to the plant(s), operate the hedge clippers to shape the plant(s) and dispose of the clippings. The plants must be sheared to the assigned shape (cut branch ends not deviating from a smooth line, in the case of a curved shape and/or from a straight line in the case of a non-curved shape or hedge row, by greater than 10 percent of the plant's height or 4 inches whichever is less). Old wood must not be removed (except in plant species which readily produce new growth on old wood) and no clippings are present (visually) within or around the plant.

PERFORMANCE GUIDE:

1. Identify shape desired for plant before plant shearing is started.
2. Select season to perform shearing:
   - A. Perform heaviest shearing in the early spring.
   - B. Perform light shearing in the late summer or early fall to further control growth if needed.
3. Shape plants so top growth does not shade the bottom of plant.

   NOTE: Top of hedge should be narrower than the bottom, to prevent shading of new growth at base of shrub.

   CAUTION: Manufacturer's safety recommendations must be followed when using hedge trimmers.
4. Head back new plant growth to form desired shape:
   - A. Cut new growth to uniform height.
   - B. Remove 1/3 - 1/2 of new growth.

   CAUTION: Cuts should be not be made in old wood, since new growth may not occur here.
5. Dispose of clippings that have been removed from plant.

CHECKLIST

DUTY Growing Plants

TASK Shear plants.

ENABLER

1. Recall hedge trimmer safety.
2. Identify plant's old growth and new growth.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**_________

DIRECTIONS TO THE EVALUATOR:

Use this checklist when evaluating a student's ability to shear plants.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Checked operational condition of hedge trimmers.		
2.	Described selected shape for the plant.		
3.	Indicated amount of plant growth removed.		
4.	Headed back new growth to desired shape.		
5.	Avoided cutting old wood.		
6.	Removed clipping from plant.		
7.	Disposed of clippings.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 81

TASK: Pot plants.

STANDARD OF PERFORMANCE OF TASK:

The plant must be potted in the center of pot with enough space, approximately 1/2 inch, between pot rim and soil line for watering. The plant must be potted at approximately the same depth at which it was previously growing.

SOURCE OF STANDARD:

Writing team of incumbent workers.
America's Garden Book.

CONDITIONS FOR PERFORMANCE OF TASK:

Knife
Plants
New or sanitized pots
Pasteurized potting medium

ENABLING OBJECTIVES:

1. Identify plants that need potted.
2. Evaluate moisture content of medium.
3. Recall knife safety.
4. Water a potted plant.
5. Mist a plant's foliage.

*RESOURCES:

1. Sunset Books. (1984). Container gardening. Menlo Park, CA: Lane Publishing Co.
2. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.
3. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
4. Sunset Books. (1983). House plants. Menlo Park, CA: Lane Publishing Co.
5. Ortho Books. (1982). All about houseplants. San Francisco, CA: Author.
6. Hirsch, D. (1977). Indoor plants comprehensive care and culture. Radnor, PA: Chilton.

***RESOURCES:** (cont.)

7. Bush-Brown, L., & Bush-Brown, J. (1967). America's garden book. New York, NY: Charles Scribner's Sons.
8. Checklist - Potting plants.

TEACHING ACTIVITIES:

1. Question students on when plants need to be potted or repotted.
2. Outline procedure used to pot plants. (* 1,2,3,4,5,6 & 7)
3. Present lecture on the importance of using sanitized or new pots.
4. Present lecture on determining pot size, shape, and material, etc.
5. Present lecture on determining the need for pruning roots. (* 4,5 & 6)
6. Present lecture on the hygroscopic properties of a media that is high in peat moss. (* 1,2 & 3)
7. Present lecture on the importance of leaving enough space between the soil line and the rim of the pot for watering.
8. Present lecture on the importance of potting the plant at approximately the same depth at which it was growing before.
9. Present lecture on the importance of watering a newly potted plant.
10. Present lecture on the importance of misting the plant to remove any media from the foliage.
11. Demonstrate how to place media in the bottom of the pot.
12. Demonstrate how to remove a plant from a pot.
13. Question students on knife safety.
14. Demonstrate how to prune the roots of a root bound plant.
15. Demonstrate how to place the plant in the center of the pot.
16. Demonstrate how to check the level of the soil line in relation to the rim of the pot.
17. Demonstrate how to fill the void between the pot and the root ball.
18. Demonstrate how to firm the medium gently.
19. Assign students to water the potted plant.
20. Assign students to mist the plant to remove any media from the foliage.
21. Monitor students as they practice potting plants.
22. Assign each student a plant to pot. (* 8)

CRITERION-REFERENCED MEASURE:

The student must select an appropriate sized pot, partially fill the pot with medium, remove the plant from the pot, prune the plant roots, place the root ball in the center of the pot, add additional medium, firm the medium, water and mist the plant. The plant must be potted (centered original depth plus or minus 1/2 inch or as specified) in an appropriately sized pot (DIA of new pot 10% to 25% of old pot) with enough space between the pot rim and the soil line for watering and with clean foliage and container (less than 1% surface area covered with medium)

PERFORMANCE GUIDE:

1. Select plants that will be potted.
2. Select sanitized or new pots of an appropriate size.
   CAUTION: An oversized pot can result in the media staying too wet for too long and thus lead to conditions favorable for root rot.
3. Place enough media in bottom of pot that selected plant will set on media and still have adequate head space, approximately 1/2 inch, at the top of the pot after the potting operation has been completed.
   NOTE: A media high in peat moss must be moistened to potting consistency before it is used.
   NOTE: Use of a wetting agent may help moisten peat moss.
4. Remove plant from pot:
   A. Turn pot upside down.
   B. Hold plant stem or plant crown with one hand.
   C. Tap rim of pot on potting table a couple of times using the other hand.
   D. Slide plant out of the pot.
5. Prune plant roots if needed:
   CAUTION: Plants that are pot bound need to be root-pruned. Any long, scraggly roots should also be pruned.
   A. Make a one inch deep cut through the entire height of the outside edge of rootball.
   B. Repeat process at two to three equidistant points on rootball.
6. Place plant in center of pot.
   NOTE: The plant must be positioned in the pot in a manner that will allow enough space between pot rim and media line for watering.

PERFORMANCE GUIDE: (cont.)

7. Add additional media in the void between pot and root ball.
8. Firm soil around root ball.
   NOTE: The media must be gently firmed around root ball, not packed.
   CAUTION: The plant must generally be potted at approximately the same depth at which it was previously grown.
9. Water the plant.
10. Remove any media from foliage and the outside of pot by misting.

CHECKLIST

DUTY Growing Plants

TASK Pot plants.

ENABLER

1. Estimate moisture content of medium.
2. Recall knife safety.
3. Water a potted plant.
4. Mist a plant's foliage.

STUDENT'S NAME__________ **DATE**__________

EVALUATOR'S NAME__________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to pot plants.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected an appropriate sized pot.		
2.	Checked moisture content of medium.		
3.	Adjusted moisture content of medium.		
4.	Placed media in the bottom of the pot.		
5.	Removed plant from pot without excess damage to foliage or rootball.		
6.	Pruned plant roots.		
7.	Placed plant in center of pot.		
8.	Removed plant and adjusted media to level of soil line.		
9.	Added medium to fill void between pot and rootball.		
10.	Firmed medium around rootball gently.		

PERFORMANCE DETERMINANTS	YES	NO
11. Watered the plant.		
12. Misted foliage to remove media.		
13. Removed medium from outside of container.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 82

TASK: Transplant trees and shrubs.

STANDARD OF PERFORMANCE OF TASK:

Trees and shrubs must be reset at their original planting depth. Bare-root trees and shrubs must be set on a mound of soil in a hole large enough for plant roots to be completely outstretched. Balled and burlapped trees and shrubs must be set in a hole twice the size of their rootball. The hole must be filled by adding soil, tamping, and watering so soil is in close contact with roots.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Spade
Shovel
Tree or shrub
Wheel barrow
Planting site
Anti-transpirant
Starter fertilizer

ENABLING OBJECTIVES:

1. Recall changes in weather conditions during different seasons of the year.
2. Evaluate soil conditions texture.
3. Distinguish ball and burlaped plants from bare-root dug plants
4. Dig a hole using a shovel.
5. Irrigate plants.

***RESOURCES:**

1. Giles, F. (1986). Landscape construction procedures, techniques, and design. Champaign, IL: Stipes Publishing Co.

***RESOURCES:** (cont.)

2. Hannebaum, L. (1980). Landscape operations. Reston, VA: Reston.
3. Ingels, J. (1987). Landscaping: Principles and practices (3rd ed.). Albany, NY: Delmar Publishers Inc.
4. Sunset Books. (1984). Landscaping illustrated. Menlo Park, CA: Lane Publishing Co.
5. Ortho Books. (1980). All about landscaping. San Francisco, CA: Author.
6. Checklist - Transplanting trees and shrubs.

TEACHING ACTIVITIES:

1. Outline procedures used to transplant trees and shrubs.
2. Question students on the season and weather conditions suitable for transplanting trees and shrubs.
3. Present lecture on handling and storage of ball and burlapped and bareroot plants. (* 1,2,3,4 & 5)
4. Question students on the effect of root loss (due to digging), on the plant.
5. Present lecture on soil conditions required for optimum root growth. (* 1,2,3,4 & 5)
6. Present lecture on planting depth. (* 1,2,3,4 & 5)
7. Assign students to dig a planting hole.
8. Present lecture on determining if the planting hole requires a drainage tile. (* 1,2,3,4 & 5)
9. Question students on their opinion of the need for starter fertilizer or other soil amendments.
10. Demonstrate how to prepare the planting hole for balled and burlapped plants.
11. Demonstrate how to prepare the planting hole for bareroot trees and shrubs.
12. Demonstrate how to set ball and burlapped plants in the planting hole.
13. Demonstrate how to set bareroot plants in the planting hole.
14. Question students on whether or not the plant is set at the same depth as its original planting depth.
15. Demonstrate how to form a shallow basin around the plant to aid in watering.
16. Assign students to irrigate the plant.
17. Question students on handling and storage of balled and burlapped plants.

TEACHING ACTIVITIES: (cont.)

18. Question students on how deep ball and burlapped and bareroot plants should be planted.
19. Assign each student a ball and burlapped and/or bareroot plant to transplant. (* 6)

CRITERION-REFERENCED MEASURE:

The student must dig the planting hole, add soil amendments if assigned, prepare the planting hole, transplant the assigned plant, form a basin around the plant and irrigate the plant. The plant must be reset at its original planting depth. Bare-root trees and shrubs must be set on a mound of soil in a hole large enough for plant roots to be completely outstretched. Balled and burlapped plants must be set in a hole twice the size of their rootball. The hole must be filled by adding soil, tamping, and watering so soil is in close contact with roots.

PERFORMANCE GUIDE:

1. Select tree or shrub that will be transplanted.
2. Determine if season and weather conditions are suitable for transplanting trees and shrubs.
3. Dig a hole for tree or shrub at the transplanting site:
   NOTE: Keep the topsoil that is removed from hole separated from the subsoil.
   A. Make hole approximately twice the size of soil ball for balled and burlapped trees and shrubs.
   B. Make hole large enough for roots to be completely outstretched for bare-root trees and shrubs.
4. Install a drainage tile in hole if area is poorly drained.
5. Add enough topsoil to the bottom of the hole that selected tree or shrub will set on topsoil and set at its original planting depth:
   CAUTION: Grafted plants must have graft planted above ground.
   A. Shape topsoil into a cone-shaped mound when planting bare-root trees or shrubs.
      NOTE: The root crown can be set on top of the mound to aid close contact between soil and roots.
   B. Place topsoil evenly across the bottom of hole for balled and burlapped trees and shrubs.

PERFORMANCE GUIDE: (cont.)

6. Add recommended amount of starter fertilizer for particular plant species to loosened topsoil in the bottom of hole.
   CAUTION: Only starter or organic fertilizer should be used. Fertilizer should be mixed with loosened soil in the bottom of the hole so it will not come in direct contact with plant roots.
7. Set tree or shrub into the hole:
   A. Bare-root trees or shrubs:
      1. Position roots on bare-root trees and shrubs so roots are outstretched.
      2. Add topsoil around base of the roots.
      3. Add additional soil around the lower roots.
      4. Eliminate air pockets by gently raising and lowering the plant or adding some water.
      5. Continue adding soil until hole is filled.
      6. Tamp the entire area with one's feet.
   B. Balled and burlapped trees or shrubs:
      1. Cut the twine that was holding the burlap in place.
      2. Loosen the burlap from the soil ball.
         NOTE: If plastic burlap has been used to wrap the soil ball, remove it.
      3. Fill the remaining space left in the hole halfway with topsoil.
      4. Tamp soil.
      5. Water tree or shrub to eliminate air pockets.
      6. Fill the remainder of the hole with topsoil.
      7. Tamp the soil.
8. Check the final soil level around tree or shrub to insure tree or shrub is set at the same depth as its original planting depth.
9. Shape the surface of the surrounding ground in the form of a shallow basin to aid in watering.
10. Irrigate trees or shrubs:
    A. Irrigate immediately after planting.
    B. Irrigate on an as needed basis until tree or shrub is established.
11. Remove any leftover soil.

CHECKLIST

DUTY Growing Plants

TASK Transplant trees and shrubs.

ENABLER

1. Recall changes in weather conditions during different seasons of the year.
2. Evaluate soil conditions.
3. Distinguish ball and burlapped plants from bare-root dug plants
4. Dig a hole using a shovel.
5. Irrigate plants.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to transplant trees and shrubs.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified packaging of plant roots.	______	______
2.	Listed the season and weather conditions suitable for transplanting trees and shrubs.	______	______
3.	Dug a hole for tree or shrub at the transplanting site.	______	______
4.	Made hole approximately twice the size of soil ball for balled and burlapped trees and shrubs.	______	______
5.	Made hole large enough for roots to be completely outstretched for bare-root trees and shrubs.	______	______
6.	Installed a drainage tile.	______	______
7.	Added enough topsoil to the bottom of the hole that selected tree or shrub would set on topsoil and set at its original planting depth.	______	______

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
8.	Shaped topsoil into a cone-shaped mound when planting bare-root trees or shrubs.	________	________
9.	Placed topsoil evenly across the bottom of hole for balled and burlapped trees and shrubs.	________	________
10.	Added recommended amount of starter fertilizer.	________	________
11.	Positioned roots on bare-root trees and shrubs so roots were outstretched.	________	________
12.	Removed twine, or loosened burlap.	________	________
13.	Added topsoil around the roots.	________	________
14.	Eliminated air pockets.	________	________
15.	Checked the final soil level around tree or shrub.	________	________
16.	Shaped the surface of the surrounding ground in the form of a shallow basin.	________	________
17.	Irrigated trees or shrubs.	________	________
18.	Removed any leftover soil.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 83

TASK: Lay weed barrier.

STANDARD OF PERFORMANCE OF TASK:

Plant bed or row must be covered by taut weed barrier. All ends and sides must be buried. Manufacturer's recommendations and safety precautions must be observed when weed barrier is laid mechanically.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Bed
Spade
Plastic
Mechanical weed barrier applicator

ENABLING OBJECTIVES:

1. Evaluate weather conditions (wind).
2. Recall motorized equipment safety.
3. Read mechanical weed barrier laying equipment operating instructions.
4. Calculate/measure square feet.

***RESOURCES:**

1. Poincelot, R. (1986). _No-dig, no-weed gardening_. Emmaus, PA: Rodale Press.
2. Klingman, G., Ashton, F., & Noordhoff, L. (1982). _Weed science: Principles and practices_ (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
3. Bush-Brown, L., & Bush-Brown, J. (1967). _America's garden book_. New York, NY: Charles Scribner's Sons.
4. Ortho Books. (1982). _Easy maintenance gardening_. San Francisco, CA: Author.
5. Mechanical weed barrier laying equipment operating instructions.
6. Checklist - Laying weed barrier.

TEACHING ACTIVITIES:

1. Present lecture on the purposes of laying a weed barrier. (* 1,2,3 & 4)
2. Question students of the effect of wind on handling weed barrier material.
3. Outline procedures used to lay weed barrier by hand. (* 1,2,3 & 4)
4. Outline procedures used to lay weed barrier mechanically. (* 5)
5. Present lecture on materials used as weed barriers. (* 1,2,3 & 4)
6. Show an example of a trench dug around a planting bed or row.
7. Demonstrate how to bury one end of the weed barrier.
8. Demonstrate how to unroll the weed barrier and bury both sides.
9. Discuss the importance of keeping the weed barrier taut.
10. Show an example of a weed barrier laying machine.
11. Demonstrate how to operate the weed barrier laying machine. (* 5)
12. Assign each student a bed row on which to lay a weed barrier by hand or mechanically. (* 6)

CRITERION-REFERENCED MEASURE:

The student must dig a trench around a planting bed or row, cover the bed or row with the weed barrier and bury the ends and edges of the weed barrier by hand or mechanically. The weed barrier must cover the assigned area, the weed barrier must be taut, mechanical weed barrier laying equipment must be used safely and the weed barrier must stay in place under normal weather conditions.

PERFORMANCE GUIDE:

1. Check weather conditions for suitability of laying weed barrier.
2. Identify method to be used in laying weed barrier:
   A. By hand:
      1. Dig trench around bed row to be covered.
      2. Secure one end of weed barrier by burying it in the trench.
      3. Unroll a small portion of weed barrier.
      4. Bury both sides of weed barrier in trench.
         CAUTION: Keep weed barrier taut to prevent wind damage to weed barrier.

PERFORMANCE GUIDE: (cont.)

  5. Repeat the unrolling and burying process until entire bed/row is covered.
  6. Secure the remaining loose end by burying in trench.

B. Mechanically:

  1. Follow manufacturer's recommendations and instructions when operating weed barrier laying machine.
  2. Follow manufacturer's safety precautions when operating machine.

CHECKLIST

DUTY Growing Plants

TASK Lay weed barrier.

ENABLER

1. Evaluate weather conditions (wind).
2. Recall motorized equipment safety.
3. Read mechanical weed barrier-laying equipment operating instructions.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to lay weed barrier.

PERFORMANCE DETERMINANTS	YES	NO
1. Checked weather conditions.	______	______
By hand:		
2. Dug trench around area to be covered.	______	______
3. Secured one end of weed barrier by burying it in the trench.	______	______
4. Unrolled a small portion of weed barrier.	______	______
5. Buried both sides of weed barrier in trench.	______	______
6. Kept weed barrier taut.	______	______
7. Covered entire bed or row.	______	______
8. Secured the remaining loose end by burying in trench.	______	______
Lay weed barrier mechanically:		
9. Followed manufacturer's recommendations and instructions when operating weed barrier laying machine.	______	______

	YES	NO
PERFORMANCE DETERMINANTS (cont.)		
10. Followed manufacturer's safety precautions when operating machine.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 84

TASK: Plant cover crops.

STANDARD OF PERFORMANCE OF TASK:

The selected cover crop seed must be sown at recommended rate, date, and depth for particular plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Site
Seeder
Herbicide
Fertilizer
Cover crop seed
Cultivation tool

ENABLING OBJECTIVES:

1. Apply herbicides.
2. Prepare soil for planting.
3. Measure square feet.
4. Calcualate seeding rate.
5. Evaluate soil moisture content.

***RESOURCES:**

1. Bosworth, D., & Foster, A. (1982). Approved practices in soil conservation. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Schwab, G., Frevert, R., Edminister, T., & Barnes, K. (1981). Soil and water conservation engineering (3rd ed.). Somerset, NJ: John Wiley and Sons, Inc.
3. Donahue, R., Follett, R., & Tulloch, R. (1983). Our soils and their management. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

4. Bennett, C. (1983). Conservation and management of natural resources in the United States. Somerset, NJ: John Wiley and Sons, Inc.
5. Page, B., & Thomson, W. (1987). Insecticide, herbicide, fungicide quick guide. Fort Atkinson, WI: Nasco.
6. Ashton, F., & Crafts, A. (1981). Modes of action of herbicides (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
7. Rice, R., Jr. (1986). Nursery and landscape weed control manual. Chicago, IL: American Nurseryman Publishing Co.
8. Klingman, G., Ashton, F., & Noordhoff, L. (1982). Weed science: Principles and practices (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
9. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers and Publishers, Inc.
10. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
11. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.
12. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.
13. Seeding equipment instructions.
14. Checklist - Planting cover crops.

TEACHING ACTIVITIES:

1. Present lecture on the purposes of planting cover crops.
2. List the different types of cover coops.
3. List factors to consider when determining the type of cover crop to plant.
4. Present lecture on hypothetical or real situation in which a cover is needed.
5. List cover crops that could be used for the hypothetical or real situation. (* 1 & 2)
6. Discuss reasons why the listed cover crops would or would not be the best cover crop to use.
7. Present lecture on application of herbicides prior to planting. (* 5,6,7 & 8)
8. Present lecture on preparation of soil prior to planting. (* 9,10,11 & 12)
9. Present lecture on methods for sowing the seed. (* 1 & 2)
10. Show an example of a site that has been treated with a herbicide and is ready for soil preparation operations.

TEACHING ACTIVITIES: (cont.)

11. Assign students to prepare the soil for planting.
12. Demonstrate how to adjust the planting equipment for seeding rate and/or planting depth.
13. Demonstrate how to sow the seed.
14. Monitor students as they practice adjusting the planting equipment and sowing the seed.
15. Assign each student an area in which to plant a cover crop. (* 14)

CRITERION-REFERENCED MEASURE:

The student must prepare the soil for planting, adjust the seeding rate and depth and sow the seed. The soil must be prepared as assigned, the selected cover crop seed must be sown at the recommended rate, date, and depth for particular plant species.

PERFORMANCE GUIDE:

1. Identify type of cover crop to plant:
    - A. Consider season of year.
    - B. Consider climatic zone.
    - C. Consider soil enrichment factors.
    - D. Consider cost of seed and application.
2. Prepare site for seeding:
    - A. Check soil moisture content.
    - B. Adjust soil pH.
    - C. Cultivate soil.
    - D. Apply herbicide, if recommended.
      CAUTION: All manufacturer's recommendations and safety precautions must be observed.
    - E. Fertilize soil.
3. Sow seed following recommended practices for particular plant species:
   NOTE: Cover crops are generally drilled or broadcast.
    - A. Sow at recommended planting date.
    - B. Sow at recommended seeding rate and depth.
4. Irrigate the site if possible.

CHECKLIST

DUTY Growing Plants

TASK Plant cover crops.

ENABLER

1. Prepare soil for planting.

STUDENT'S NAME ______________________________ **DATE** __________

EVALUATOR'S NAME ______________________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plant cover crops.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Prepared site for seeding:		
- Checked soil moisture content.	______	______
- Adjusted soil pH.	______	______
- Cultivated soil.	______	______
- Applied herbicide.	______	______
- Fertilized soil.	______	______
2. Sowed seed at recommended planting date.	______	______
3. Sowed seed at recommended seeding rate.	______	______
4. Sowed seed at recommended seeding depth.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 85

TASK: Apply mulch to a planting bed.

STANDARD OF PERFORMANCE OF TASK:

A mulch that allows aeration must be selected and uniformly applied at predetermined depth to weed-free bed. Mulch must be applied at a lesser depth at stem or crown of plant than rest of bed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Bed
Mulch
Plants
Shovel
Spreader
Pitchfork

ENABLING OBJECTIVES:

1. Distinguish weeds from desirable plants.
2. Recall characteristics of mulches (aeration/water retention).
3. Calculate/measure square feet.
4. Calculate cubic feet.

***RESOURCES:**

1. Poincelot, R. (1986). No-dig, no-weed gardening. Emmaus, PA: Rodale Press.
2. Klingman, G., Ashton, F., & Noordhoff, L. (1982). Weed science: Principles and practices (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
3. Bush-Brown, L., & Bush-Brown, J. (1967). America's garden book. New York, NY: Charles Scribner's Sons.
4. Ortho Books. (1982). Easy maintenance gardening. San Francisco, CA: Author.
5. Checklist - Applying mulch to planting bed.

TEACHING ACTIVITIES:

1. Present lecture on the purpose of applying mulch. (* 1,2,3 & 4)
2. Show examples of different types of mulches.
3. Question students on the characteristics (aeration/water retention) of the mulches.
4. Present lecture on the depth that mulch should be applied at the plant's crown/stem. (* 1,2,3 & 4)
5. Present lecture on the depth of the mulch needed for weed control versus water retention. (* 1,2,3 & 4)
6. Show area to be mulched.
7. Assign students to remove any weeds.
8. Demonstrate how to load transport and dump mulch.
9. Demonstrate how to spread the mulch.
10. Assign each student a planting bed to mulch. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select the mulch, remove any weeds, and apply the mulch. The selected mulch must allow aeration, all weeds must be removed and the mulch must be applied uniformly or at a lesser depth at stem or crown of plant.

PERFORMANCE GUIDE:

1. Remove any weeds which are present.
   NOTE: Weeds may be removed by hand, cultivation, or by herbicides. A pre-emergence herbicide may be applied at this time.
2. Select type of mulch to be used:
   NOTE: Mulches may affect soil pit.
   A. Inorganic mulch.
   B. Organic mulch.
      NOTE: Inorganic mulch may have to be removed from bed if plants are moved from the bed. Organic mulch can eventually be incorporated into soil if desired.
      NOTE: Fresh organic mulch may deplete soil nitrogen (carbon to nitrogen ratio) nitrogen applications may be required.
3. Apply mulch around stem or crown of plants at a lesser depth than the rest of the bed.
4. Spread mulch evenly over bed:
   A. Apply 4-6 inches deep for weed control.

CHECKLIST

DUTY Growing Plants

TASK Apply mulch to a planting bed.

ENABLER

1. Distinguish weeds from desirable plants.
2. Recall characteristics of mulches (aeration/water retention).

STUDENT'S NAME____________________ **DATE**__________

EVALUATOR'S NAME____________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to mulch planting beds.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Removed weeds.		
2.	Identified type of mulch to be used.		
3.	Applied mulch deep enough to control weeds.		
4.	Applied mulch around stem or crown of plants at a lesser depth than the rest of the bed.		
5.	Spread mulch evenly over bed.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 86

TASK: Label plants.

STANDARD OF PERFORMANCE OF TASK:

All labels must be written with pencil or waterproof ink. Plant labels must include: species name, cultivar name, date planted, treatment, and the name of the worker.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Labels
Pencil
Waterproof pen
Grease pencil
Block of plants

ENABLING OBJECTIVES:

1. Print or write small and legibly.
2. Recall abbreviations used in place of complete plant names, dates and treatments.
3. Identify plant species and cultivar.

***RESOURCES:**

1. Growing container plants: A guide to production in the high school greenhouse. Fort Atkinson, WI: Nasco.
2. Sunset Books. (1984). Container gardening. Menlo Park, CA: Lane Publishing Co.
3. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
4. Checklist - Labeling plants.

TEACHING ACTIVITIES:

1. Discuss the importance of accurately labeled plants.
2. Show examples of weather proof labels.

TEACHING ACTIVITIES: (cont.)

3. Demonstrate the effect of water on labels written using a pencil, a waterproof pen and a non-water proof pen.
4. Question students on what information could be included on a plant label. (* 1,2 & 3)
5. Show examples of completed labels.
6. Demonstrate how to place a label in the container without obscuring the message.
7. Demonstrate how to place a label in a block of plants.
8. Monitor the students as they practice labeling plants.
9. Assign each student a block of plants to label. (* 4)

CRITERION-REFERENCED MEASURE:

The student must record the specified information on the label and place the label in the block of plants. All specified information must be recorded legibly on the label with a waterproof marker and the label must be placed so the message is not obscured and the plants corresponding to the label can be discerned.

PERFORMANCE GUIDE:

1. Select weatherproof label.
2. Print specified information on label, generally starting at the top and printing lengthwise down the label toward the pointed end, leaving room for the label to be inserted into the container without obscuring the message.
3. Place label in medium using the predetermined method:

   CAUTION: To avoid confusion of cultivars, all plants at a specified horticultural business must be labeled by the same method.

   A. Place the plant bearing the label in the upper left hand corner of the block as you face it from the aisle and then people will know that all plants in front of and to the right will be the same cultivar.
   B. Place the label at the front of the left row, then all plants in rows to the right will be the same cultivar.

CHECKLIST

DUTY Growing Plants

TASK Label plants.

ENABLER

1. Print or write small and legibly.
2. Recall abbreviations used in place of complete plant names, dates and treatments.

STUDENT'S NAME________________ **DATE**________

EVALUATOR'S NAME________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use this checklist to evaluate the student's ability to label plants.

PERFORMANCE DETERMINANTS	YES	NO
1. Recorded the plants species name.	____	____
2. Recorded the plants cultivator name.	____	____
3. Recorded the date planted.	____	____
4. Recorded treatment.	____	____
5. Recorded other information about the plant as required.	____	____
6. Placed label in the container without obscuring the message.	____	____
7. Placed label using method that allows for the location of the corresponding plants to be discerned.	____	____

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 87

TASK: Disbud plants.

STANDARD OF PERFORMANCE OF TASK:

Lateral buds must be removed from plant without damaging the leaves and stems. Sanitation practices must be observed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Trash bucket
Disinfestant
Growth regulator (chemical pinching agent)
Flowering plant (prior to the appearance of flower buds)

ENABLING OBJECTIVES:

1. Look up a plant's cultural requirement in a crop manual.
2. Distinguish flower buds from vegetative buds.
3. Recall horticultural chemical safety.
4. Recognize turgid plants.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Shumack, R., & Williams, G. (1983). Greenhouse flowers and bedding plants. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
5. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
6. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
7. Growth regulator label.
8. Checklist - Disbudding plants.

TEACHING ACTIVITIES:

1. Present lecture on the purpose of disbudding plants. (* 1,2,3,4,5 & 6)
2. List crops (plant name and purpose of crop) for which disbudding is recommended. (* 7)
3. Show examples of plants that were and were not disbudded.
4. Show examples of plant's with and without a terminal flower bud.
5. Present lecture on chemical disbudding. (* 1,2,3,4,5 & 6)
6. Present lecture on disbudding by hand. (* 1,2,3,4,5 & 6)
7. Discuss the importance of sanitation when disbudding by hand.
8. Show examples of turgid and wilted plants.
9. Discuss the importance of removing lateral shoots by hand only when the plants are turgid.
10. Show examples of plants with lateral buds that are too small to handle, correct size for disbudding and overdue for disbudding.
11. Demonstrate how to remove lateral shoots by hand.
12. Question students on which buds are vegetative and which buds are floral.
13. Question students on horticultural chemical safety.
14. Assign each student a block of plant to disbud by hand or using a chemical pinching agent. (* 8)

CRITERION-REFERENCED MEASURE:

The student must identify plants with terminal flower buds, and apply a chemical pinching agent or remove the lateral buds by hand. All plants with terminal flower buds must be identified, chemical pinching agents must be applied safely and/or lateral buds must be removed by hand without damage to the leaves and stems and sanitation practices must be observed.

PERFORMANCE GUIDE:

1. Select plant species recommended for disbudding.
2. Check plant to determine if the terminal flower bud is present.
3. Check plant often for the appearance of lateral buds, after the terminal bud has been observed.

PERFORMANCE GUIDE: (cont.)

4. Identify method of disbudding that is to be used:
    A. Chemical disbudding:
        1. Apply plant growth regulator that can be used as a chemical disbudding agent following manufacturer's recommendations.
           CAUTION: Follow all safety precautions recommended by manufacturer.
    B. Hand disbudding:
       NOTE: Disbudding should be performed while plant is turgid.
        1. Remove lateral buds as soon as they can be grasped with one's fingers without damaging the leaves and stems.
           CAUTION: Do not delay disbudding once the buds can be physically handled. Delay of disbudding will reduce the size of the terminal flower and increase stem damage.
        2. Dip hands in disinfestant often to avoid the spread of plant diseases.
        3. Deposit lateral flower buds in a trash bucket as they are removed.

CHECKLIST

DUTY Growing Plants.

TASK Disbud plants.

ENABLER

1. Look up a plant's cultural requirement in a crop manual.
2. Distinguish flower buds from vegetative buds.
3. Recall growth regulator safety.
4. Operate application equipment.
5. Recognize turgid plants.

STUDENT'S NAME____________________**DATE**__________

EVALUATOR'S NAME____________________**COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to disbud plants.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Checked plants for terminal flower bud.		
2.	Checked plant to determine if plant was turgid.		
3.	Checked plant for the appearance of lateral buds.		
4.	Distinguish between vegetable and flower buds.		
5.	Identified flower and beginning buds.		
6.	Applied plant growth regulator.		
7.	Followed manufacturer's recommendations.		
8.	Checked plants to determine if they were turgid.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
9.	Removed lateral buds as soon as they could be grasped.	________	________
10.	Avoided damage to the leaves and stems.	________	________
11.	Dipped hands in disinfestant.	________	________
12.	Deposited lateral flower buds in a trash bucket.	________	________
13.	Checked plants weekly after lateral buds had been removed.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 88

TASK: Stake plants.

STANDARD OF PERFORMANCE OF TASK:

Staking must provide for plant support and growth control while allowing stem movement. Tying material must not cut or scar the plant stem.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Stakes
Plants
Tying material

ENABLING OBJECTIVES:

1. Predict plant growth.
2. Identify direction of prevailing wind.

***RESOURCES:**

1. Hannebaum, L. (1980). Landscape operations. Reston, VA: Reston.
2. Giles, F. (1986). Landscape construction procedures, techniques, and design. Champaign, IL: Stipes Publishing Co.
3. Ingels, J. (1987). Landscaping: Principles and practices (3rd ed.). Albany, NY: Delmar Publishers Inc.
4. Ortho Books. (1980). All about landscaping. San Francisco, CA: Author.
5. Sunset Books. (1984). Landscaping illustrated. Menlo Park, CA: Lane Publishing Co.
6. Pirone, P. (1972). Tree maintenance (5th ed.). New York, NY: Oxford University Press.
7. Checklist - Staking plants.

TEACHING ACTIVITIES:

1. Present lecture on the purpose(s) of staking. (* 1,2,3,4,5 & 6)
2. Present lecture on proper placement of stake.

TEACHING ACTIVITIES: (cont.)

3. Present lecture on the negative effects of staking plants. (* 1,2,3,4,5 & 6)
4. Present lecture on the length of time staking material should remain attached to the plant.
5. Present lecture on situation on which plants should be staked.
6. Show examples of materials used to stake plants.
7. Present lecture on staking methods. (* 1,2,3,4,5 & 6)
8. Demonstrate how to attach the tying material to the plant without causing girdling of the plant stem.
9. Monitor students as they practice attaching tying material to the plant.
10. Demonstrate how to stake plants.
11. Question students on the direction of the prevailing wind.
12. Assign each student a plant(s) to stake. (* 7)

CRITERION-REFERENCED MEASURE:

The student must select the staking method and stake the plant. The staking must provide for plant support and growth control while allowing stem movement and the tying material must not cut or scar the plant stem (no visible damage).

PERFORMANCE GUIDE:

1. Identify specific plants requiring staking, considering:
   A. Growth habit.
   B. Present appearance of plant.
   C. Direction and strength of wind.
   CAUTION: Stake only when necessary and for the shortest period of time because stems of staked plants tend to be weaker than stems of plants that have not been staked.
2. Choose stake best suited for particular plant species:
   A. Three-legged circular wire stand.
   B. Wooden or metal stake approximately 3/4 the length of plants height.
   C. Guy wires positioned in 3 places around the plant and bolted or staked into the ground.
3. Insert stakes into the soil next to plant to a depth that will anchor the plant.

PERFORMANCE GUIDE: (cont.)

4. Loop tying material loosely around plant stem and tie tightly to the stake.
   CAUTION: The material used for tying must not cut into plant's stem. Soft twine, soft material, or wire inserted inside a garden hose are generally used to tie plant stems.

CHECKLIST

DUTY Growing Plants

TASK Stake plants.

ENABLER

1. Predict plant growth.
2. Identify direction of prevailing wind.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to stake plants.

PERFORMANCE DETERMINANTS	YES	NO
1. Chose staking method best suited for plant species.	______	______
2. Inserted stakes into the soil.	______	______
3. Looped tying material loosely around plant stem.	______	______
4. Tied tying material tightly to the stake.	______	______
5. Staked plant has some movement.	______	______
6. Staked plant does not have visible damage due to staking.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 89

TASK: Pinch plants.

STANDARD OF PERFORMANCE OF TASK:

The tip of plant's growing shoot must be removed without damage to plant. The severity of pinch must equal the recommendations for particular plant species. Sanitation practices must be observed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Disinfestant
Trash bucket
Reference manual
Disinfested knife
Disinfested shears
Disinfested pruning clippers
Growth regulator (chemical pinching agent)
Plant (new vegetative growth must be present)

ENABLING OBJECTIVES:

1. Read plant production schedule.
2. Look up the cultural requirements of a plant.
3. Identify external parts of a plant stem.
4. Recognize soft and semiwoody vegetative growth.
5. Recall horticultural chemical safety.
6. Recall pruning tool safety.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Ortho Books. (1978). All about pruning. San Francisco, CA: Author.
4. John P., Baumgardt. M., Barrow & Co. Paperback. How to prune almost everything. Fort Atkinson, WI: Nasco.

***RESOURCES:** (cont.)

5. Sunset Books. (1983). Pruning handbook. Menlo Park, CA: Lane Publishing Co.
6. Plant production schedule.
7. Checklist - Pinching plants.

TEACHING ACTIVITIES:

1. Present lecture on the purpose of pinching plants. (* 1,2,3,4, & 5)
2. Present lecture on factors to consider when determining if pinching is desirable.
3. Show examples of plants that were and were not pinched.
4. List crops (plant name and purpose of crop) for which pinching is recommended. (* 1,2,3,4, & 5)
5. List resources available for determining the cultural requirements of the listed crops.
6. Assign students to look up timing of previous plant production schedule. (* 6)
7. Present lecture on importance of checking production schedule or growth to determine the timing of the pinch.
8. Present lecture on chemical pinching. (* 1,2,3,4, & 5)
9. Present lecture on hand pinching methods.
10. Discuss the importance of sanitation when pinching.
11. Question students on the identification of soft and semiwoody tissue.
12. Demonstrate how to pinch a plant by hand.
13. Question students on growth regulator safety.
14. Present lecture on disposal and/or use (cuttings) of removed plant tops.
15. Monitor students as they pinch plants by hand and/or using a growth regulator.
16. Assign each student a block of plants to pinch by hand or using a growth regulator. (* 7)

CRITERION-REFERENCED MEASURE:

The student must list the recommendations regarding the pinching of the plant and pinch the plants by hand or using a growth regulator. The listed recommendations must be the same as is listed by the resource materials. The tip of the plant's growing shoot must be removed without visible damage to the plant. Plants treated with a growth regulator branch similar to plants treated by the test administrator.

PERFORMANCE GUIDE:

1. Check reference manual to determine if pinching this particular plant species will produce a more desirable plant.
2. Check plant to determine if new vegetative growth is present.
3. Check plant production schedule to determine the timing of the pinch.
4. Identify method of pinching:
    A. Chemical pinching:
        1. Apply plant growth regulator that can be used as a chemical pinching agent.
        2. Follow all manufacturer's recommendations and safety precautions during application process.
    B. Hand pinching:
        1. Determine type of pinch to perform:
            a. Give plants a "soft pinch" (small pinch in the soft tissue) to promote the most "breaks" (sprouts).
            b. Give plants a "hard pinch" (large pinch in the semiwoody stem tissue) to reduce plant size and to promote a limited amount of "breaks".
        2. Remove the tip of the growing shoot at a node.
            a. Perform pinching operation by pinching plant shoot with one's thumb and forefinger.

CHECKLIST

DUTY Growing Plants

TASK Pinch plants.

ENABLER

1. Read plant production schedule.
2. Look up the cultural requirements of a plant.
3. Identify external parts of a plant stem.
4. Recognize soft and semiwoody vegetative growth.
5. Recall horticultural chemical safety.
6. Recall pruning tool safety.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to pinch plants.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Identified method of pinching.	______	______
Chemical Pinch:		
2. Checked plant to determine if new vegetative growth was present.	______	______
3. Checked plant production schedule to determine the timing of the pinch.	______	______
4. Applied plant growth regulator.	______	______
5. Followed all manufacturer's recommendations and safety precautions during application process.	______	______
6. Recorded type of pinch to perform.	______	______
Pinching by hand:		
7. Gave plants a "soft pinch".	______	______
8. Gave plants a "hard pinch".	______	______
9. Removed the tip of the growing shoot at a node.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 90

TASK: Perform simple plant tissue test.

STANDARD OF PERFORMANCE OF TASK:

The plant tissue test for specific leaves only sample must be determined and performed. All manufacturer's directions on plant tissue testing must be followed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Plants
Distilled water
Plant tissue test kit

ENABLING OBJECTIVES:

1. Recall plant nutrient names.
2. Read plant tissue test kit instructions.
3. Recall units of measurement for mass and volume.

***RESOURCES:**

1. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Engelstad, O. (1985). Fertilizer technology and use. Madison, WI: Soil Science Society of America, Inc.
3. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
5. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
6. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.

***RESOURCES:** (cont.)

7. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
8. Plant tissue test kit instructions.
9. Checklist - Performing simple plant tissue tests.

TEACHING ACTIVITIES:

1. Question students on plant nutrient names.
2. Present lecture on the purposes of and/or advantages of foliar analysis. (* 1,2,3,4,5,6 & 7)
3. Outline procedures used to perform a simple plant tissue test. (* 8)
4. Show examples of test kits.
5. Question students on how they would select leaves to be tested.
6. Present lecture on selection of leaves for tissue testing. (* 1,2,3,4,5,6,7 & 8)
7. Assign students to collect leaves.
8. Assign students to rinse the leaves.
9. Discuss the importance of rinsing with distilled water.
10. Demonstrate how to extract the soluble nutrients.
11. Demonstrate how to determine the soluble nutrients that were extracted.
12. Demonstrate how to determine the level at which the nutrients are present.
13. Question students on sampling techniques.
14. Assign each student a block of plants for which to perform a simple plant tissue test. (* 9)

CRITERION-REFERENCED MEASURE:

The student must collect a leaf sample, rinse the leaves, extract the soluble nutrients and record the soluble nutrients present and record levels at which they are present. The collected leaf sample must be representative, the rinsed leaves must be free of salt and pesticide residues (visual inspection of dried leaves), and the recorded levels of soluble nutrients must be the same as the results obtained by the test administrator (plus or minus 10%).

PERFORMANCE GUIDE:

1. Obtain a representative leaf sample of crop:
   A. Select leaves from different areas on plant.

PERFORMANCE GUIDE: (cont.)

B. Select plants randomly from the same growing block.

NOTE: Manufacturer's instructions must be followed for obtaining leaf sample.

2. Rinse leaves with distilled water, if recommended.
3. Extract soluble nutrients following manufacturer's directions.
4. Identify the soluble nutrients that are extracted by following manufacturer's directions.
5. Identify the level at which soluble nutrients are present in leaf tissue by following manufacturer's directions.

CHECKLIST

DUTY Growing Plants

TASK Performing simple plant tissue test.

ENABLER

1. Recall plant nutrient names.
2. Read plant tissue test kit instructions.
3. Measure volume of a liquid.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to perform simple plant tissue test.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Collected a representative leaf sample of crop:		
- Selected leaves from different areas on plant.	______	______
- Selected plants randomly from the same growing block.	______	______
2. Rinsed leaves with distilled water, if recommended.	______	______
3. Extracted soluble nutrients following manufacturer's directions.	______	______
4. Listed the soluble nutrients that were extracted.	______	______
5. Recorded the level at which soluble nutrients were present in leaf tissue.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 91

TASK: Interpret simple plant tissue test.

STANDARD OF PERFORMANCE OF TASK:

Specific levels of nitrogen, phosphorus, potassium, and trace elements must be identified from the plant tissue test results, compared to standard foliar nutrient values for specified species, and recorded.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Soil test results
Foliar Nutrient Standards
Simple tissue test results
Past plant production records
Current plant production records

ENABLING OBJECTIVES:

1. Evaluate plant tissue test results and soil test results.
2. Recall plant nutrient names.
3. Look up standard foliar nutrient levels for a plant.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

5. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.
6. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
7. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley and Sons, Inc.
8. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
9. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.
10. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.
11. Kohnke, H. (1980). Soil science simplified. Fort Atkinson, WI: Nasco.
12. Simple plant tissue test results.
13. Soil test results.
14. Past plant production records.
15. Current plant production records.
16. Checklist - Interpreting simple plant tissue tests.

TEACHING ACTIVITIES:

1. Present lecture on the advantages of plant tissue tests over soil tests. (* 1,2,3,4,5 & 6)
2. Show an example of the results from a simple plant tissue test. (* 12)
3. List resources available to help determine the standard foliar nutrient levels for a particular plant.
4. Assign students to lookup the standard foliar nutrient levels for a particular plant.
5. List the discrepancies between the plant tissue test results and the standard foliar nutrient levels for a particular plant. (* 12)
6. Present lecture on the problems associated with major versus minor discrepancies.
7. Summarize the recommendation's of a recent soil test. (* 13)
8. Summarize the crop's past and/or current cultural program. (* 14 & 15)
9. Question students on changes that could be made in the cultural program to improve plant growth.
10. Discuss the student's recommendations for changes in the cultural program.
11. Assign each student a block of plants for which to develop a cultural program after interpreting the samples plant tissue test. (* 16)

CRITERION-REFERENCED MEASURE:

The student must list the discrepancies between the plant tissue test and the standard foliar nutrient levels and recommend changes in the cultural program to improve plant growth. The recommended changes in the cultural program must, when implemented, correct the plant's nutrient deficiencies (test administrator's judgement).

PERFORMANCE GUIDE:

1. Obtain results of simple tissue test.
2. Compare results with standard values to determine the relative nutritional status.
3. Plan a cultural program for specified crop that will improve plant growth:
   A. Study the foliar nutritional status of specified crop.
   B. Consider recommendations from a recent soil test.
   C. Use information on fertilizer program and cultural practices from plant production records.

CHECKLIST

DUTY Growing Plants

TASK Interpret simple plant tissue test.

ENABLER

1. Evaluate plant tissue test results and soil test results.
2. Recall plant nutrient names.
3. Look up standard foliar nutrient levels for plants.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to interpret simple plant tissue test.

PERFORMANCE DETERMINANTS	YES	NO
1. Explained the results of a simple tissue test.		
2. Listed standard foliar nutrient levels for the plant species.		
3. Recorded discrepancies between the plant tissue test and the standard foliar levels.		
4. Listed changes in cultural program to improve plant growth.		
5. Recorded changes on cultural program to improve plant growth.		
6. Explained why changes in the cultural program did or did not work.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 92

TASK: Calculate liquid fertilizer concentrations.

STANDARD OF PERFORMANCE OF TASK:

The fertilizer concentration for the specified frequency of application must equal the fertility needs of the specified crop.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop
Nutrient formula chart
Fertilizer requirements

ENABLING OBJECTIVES:

1. Recall units of measurement (volume/weight/area).
2. Recall plant nutrient names.
3. Look up the fertilization recommendation for a plant.
4. Read fertilizer label.
5. Add, subtract, multiply and/or divide.

***RESOURCES:**

1. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.
3. Sunset Books. (1984). Container gardening. Menlo Park, CA: Lane Publishing Co.
4. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
5. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
6. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

7. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
8. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.
9. Fertilizer label.
10. Fertilizer injector operating intructions.
11. Proportioner operating instructions.
12. Checklist - Calculating fertilizer concentrations.

TEACHING ACTIVITIES:

1. Discuss the importance of avoiding over fertilization and under fertilization. (* 1,2,3,7 & 8)
2. List methods and/or systems used to apply fertilizer. (* 2,3,4,5 & 6)
3. List examples of nutrient recommendations for specific plants. (* 2,3,4,5,6 & 9)
4. Present lecture on the differences between the concentrations used for constant feed and intermittent feed. (* 2,3,4,5 & 6)
5. Assign students to look up the fertilization recommendations for a list of plants.
6. Present lecture on fertilizer injectors and/or proportioners. (* 2,3,4,5,6,10 & 11)
7. Present lecture on formulas used to calculate fertilizer concentrations that together deliver the recommended ppm of nutrients to the plant.
8. Demonstrate how to use a nutrient formula chart.
9. Assign each student a list of plants and injectors/proportioner ratios for which to calculate the fertilizer concentrations. (* 12)

CRITERION-REFERENCED MEASURE:

The student must determine and list the plant nutrient recommendation, and determine the amount of soluble nutrient needed to make 1 gallon of fertilizer concentrate. The recorded plant nutrient recommendation must be the same as is listed in the reference materials and the amount of soluble nutrients delivered by the injector/proportioner must be accurate (plus/minus 1%).

PERFORMANCE GUIDE:

1. Identify fertilizer requirements for specified crop being fertilized.
2. Select frequency of fertilizer application:
   - A. Constant feed.
   - B. Intermittent feed (generally every 2nd or 3rd irrigation).
3. Calculate the ratio at which injector or proportioner mixes fertilizer concentration with irrigation water.
4. Calculate the amount of soluble fertilizer needed to make fertilizer concentration:
   - A. Obtain a nutrient formula chart.
   - B. Find injection ratio and desired ppm of nutrient on nutrient formula chart.
   - C. Calculate amount of soluble fertilizer needed to make 1 gallon of fertilizer concentrate.

CHECKLIST

DUTY Growing Plants

TASK Calculate fertilizer concentrations.

ENABLER

1. Recall units of measurement (volume/weight).
2. Recall plant nutrient names.
3. Look up the fertilization recommendation for a plant.
4. Read fertilizer label.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to calculate fertilizer concentrations.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed fertilizer requirements for specified crop being fertilized.	________	________
2. Listed the ratio at which injector or proportioner mixes fertilizer concentration with irrigation water.	________	________
3. Listed the amounts of soluble fertilizer and water to use to make fertilizer concentration.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 93

TASK: Prepare fertilizer solution.

STANDARD OF PERFORMANCE OF TASK:

The prepared fertilizer solution must contain the specified concentration of nutrients. The solution must be uniform and contain no undissolved nutrients.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Dye
Scales
Soluble nutrients
Gallon measurement
Proportioner or injector
Fertilizer container/tank

ENABLING OBJECTIVES:

1. Recall units of measurement (volume/weight).
2. Recall horticultural chemical safety.
3. Recognize undissolved materials.
4. Read fertilizer label.

***RESOURCES:**

1. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
2. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers & Publishers, Inc.
3. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
4. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
5. Fertilizer label.
6. Checklist - Preparing fertilizer solution.

TEACHING ACTIVITIES:

1. Outline procedures used to prepare fertilizer solution.
2. Present lecture on problems that could arise if the fertilizer solution was prepared incorrectly. (1,2,3 & 4)
3. Question students on units of measurement.
4. Demonstrate how to use scales and volume measuring devices.
5. Monitor students as they practice mass and volume measurements.
6. Present lecture on the relative solubility of soluble nutrients when using cold, warm or hot water and the importance of avoiding undissolved nutrients.
7. Demonstrate the mixing of a pre-measured amount of soluble nutrients with a pre-measured amount of warm water.
8. Question students on how to determine the extent that the soluble nutrients are undissolved.
9. Question students on horticulture safety.
10. Assign each student fertilizer stock solution recipe to prepare. (* 5)

CRITERION-REFERENCED MEASURE:

The student must measure a predetermined amount of warm water, soluble nutrient(s) and/or dye (margin of error plus or minus 5%). After the test administrator has approved the student's measurements, the student must mix the warm water, soluble nutrient(s) and/or dye with no visible evidence of undissolved nutrient(s).

PERFORMANCE GUIDE:

1. Weigh out predetermined amount of soluble nutrients.
   CAUTION: All measurements must be accurate to prevent over fertilization or under fertilization.
2. Weigh out predetermined amount of dye.
3. Measure predetermined amount of warm water.
4. Mix nutrients, dye, and water until dissolved.
5. Pour fertilizer concentrate in fertilizer container or tank of proportioner or injector.

CHECKLIST

DUTY Growing Plants

TASK Prepare fertilizer solution.

ENABLER

1. Recall units of measurement (volume/weight).
2. Recall horticulture chemical safety.
3. Recognize undissolved materials.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare fertilizer solution.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Identified fertilizer solution ingredients.		
2.	Measured predetermined amounts of soluble nutrients.		
3.	Measured predetermined amount of dye.		
4.	Measured predetermined amount of warm water.		
5.	Mixed nutrients, dye and warm water.		
6.	Identified undissolved materials.		
7.	Avoided inclusion of foreign matter in the fertilizer solution.		
8.	Labeled fertilizer solution.		
9.	Stored fertilizer solution.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 94

TASK: Fertilize plants.

STANDARD OF PERFORMANCE OF TASK:

Fertilizer must be uniformly applied to plants at recommended rate for particular plant species. All manufacturer's recommendations and safety precautions must be observed during application process.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Plants
Punch-bar
Fertilizer
Proportioner
Fertilizer injector
Fertilizer spreader
Fertilizer applicator

ENABLING OBJECTIVES:

1. Evaluate soil moisture content.
2. Irrigate plants.
3. Calibrate fertilizer spreader.
4. Recall units of measurement (weight/volume).

***RESOURCES:**

1. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.
3. Tisdale. (1985). Soil fertility and fertilizers (4th ed.). New York, NY: Macmillan.

***RESOURCES:** (cont.)

4. Israelsen, O., & Hansen, V. (1980). Irrigation principles and practices. Fort Atkinson, WI: Nasco.
5. Irrigation system operating instructions.
6. Fertilizer spreader operating instructions.
7. Checklist - Fertilizing plants.

TEACHING ACTIVITIES:

1. List methods used to fertilize plants. (* 1)
2. Present lecture on the types of plants fertilized using the listed methods. (* 1)
3. Discuss the importance of avoiding applications of fertilizer to plants when media is dry.
4. Present lecture on the function of a fertilizer injector/proportioner. (* 4 & 5)
5. Demonstrate how to attach fertilizer injector/proportioner to irrigation system.
6. Demonstrate how to set injector/proportioner.
7. Question students on how to determine if injector/proportioner is working.
8. Assign a student to irrigate the plants.
9. Demonstrate how to disconnect the injector/proportioner and flush the irrigation system.
10. Demonstrate how to operate a fertilizer spreader. (* 6)
11. Demonstrate how to set the change the rate at which the fertilizer is released. (* 6)
12. Question students on how to calibrate a fertilizer spreader.
13. Assign students to calibrate a fertilizer spreader.
14. Demonstrate how to punch holes around the circumference of a plant.
15. Assign students to place a predetermined amount of fertilizer on each hole.
16. Demonstrate how to close the holes.
17. Assign each student a plant(s) to fertilize. (* 7)

CRITERION-REFERENCED MEASURE:

The student must check the soil moisture content and apply the fertilizer according to the assigned method. The fertilizer must be applied uniformly to moist soil at the assigned rate. All manufactures safety precautions and recommendations must be observed and all fertilizer must be removed from the equipment.

PERFORMANCE GUIDE:

1. Identify plants to be fertilized.
   NOTE: Do not fertilize plants unless media is moist to avoid root burn.
2. Identify method of applying fertilizer:
   A. Make liquid application of fertilizer:
      1. Attach fertilizer proportioner or injector and fertilizer concentrate to irrigation system.
         CAUTION: Follow manufacturer's recommendations and safety precautions for operation of proportioner or injector.
      2. Set proportioner or injector at predetermined ratio.
      3. Turn on irrigation system.
      4. Check irrigation water to insure proportioner/ injector is working.
         NOTE: Dye is generally added to fertilizer concentrate so fertilizer can be detected in irrigation water.
      5. Irrigate plants uniformly.
      6. Turn off irrigation system.
      7. Disconnect proportioner or injector.
      8. Flush irrigation lines to remove any fertilizer remaining in lines.

   B. Top-dress with dry or slow-release fertilizer:
      NOTE: Fertilizer may be broadcast applied in bands near the plant row, or injected onto the medium in the container.
      1. Calibrate fertilizer spreader, applicator, or injector.
      2. Fill fertilizer spreader, applicator, or injector with predetermined amount of fertilizer.
      3. Apply fertilizer uniformly.
         NOTE: Follow manufacturer's recommendations and safety precautions while operating fertilizer spreader, applicator, or injector.
      4. Clean fertilizer spreader, applicator, or injector.
      5. Water fertilizer into the soil.

PERFORMANCE GUIDE: (cont.)

C. Use punch-bar method to apply dry or slow-release fertilizer:
   1. Punch predetermined amount of holes at uniform intervals around the circumference of the plant near the drip line.
   2. Place predetermined amount of fertilizer in each hole.
   3. Close hole by pressing surrounding soil with foot.

CHECKLIST

DUTY Growing Plants

TASK Fertilize plants.

ENABLER

1. Evaluate soil moisture content.
2. Irrigate plants.
3. Calibrate fertilizer spreader.
4. Recall units of measurement (weight/volume).

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to fertilize plants.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified plants to be fertilized.	______	______
Make liquid application of fertilizer:		
2. Attached fertilizer proportioner or injector and fertilizer concentrate to irrigation system.	______	______
3. Set proportioner or injector at predetermined ratio.	______	______
4. Turned on irrigation system.	______	______
5. Checked irrigation water.	______	______
6. Irrigated plants.	______	______
7. Turned off irrigation system.	______	______
8. Disconnected proportioner or injector.	______	______
9. Flushed irrigation lines to remove any fertilizer remaining in lines.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Top-dress with dry or slow-release fertilizer:		
10. Calibrated fertilizer spreader, applicator, or injector.	________	________
11. Filled fertilizer spreader, applicator, or injector with predetermined amount of fertilizer.	________	________
12. Applied fertilizer.	________	________
13. Followed manufacturer's recommendations and safety precautions while operating fertilizer spreader, applicator, or injector.	________	________
14. Cleaned fertilizer spreader, applicator, or injector.	________	________
15. Watered fertilizer into the soil.	________	________
Use punch-bar method to apply dry or slow-release fertilizer:		
16. Punched predetermined amount of holes around the circumference of the plant near the drip line.	________	________
17. Placed predetermined amount of fertilizer in each hole.	________	________
18. Closed hole.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 95

TASK: Inspect crops for pests.

STANDARD OF PERFORMANCE OF TASK:

Pests and pest damage must be listed for specified crop.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop
Plant records

ENABLING OBJECTIVES:

1. Recall normal appearance of crop.
2. Recall stages of growth during which plants are susceptable for pests.
3. Read crop records.

***RESOURCES:**

1. Chase, A. (1987). Compendium of ornamental foliage plant diseases. Chicago, IL: American Nurseryman Publishing Co.
2. Ware, G. (1980). Complete guide to pest control. Fresno, CA: Thompson Publications.
3. Metcalf, C., Flint, W., & Metcalf, R. (1962). Destructive and useful insects (4th ed.). Manchester, MO: McGraw-Hill Book Co.
4. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
5. Price, P. (1984). Insect ecology (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
6. Metcalf, R., & Luckmann, W. (1982). Introduction to insect pest management. Somerset, NJ: John Wiley and Sons, Inc.
7. Carr, A. (1983). Rodale's color handbook of garden insects. Emmaus, PA: Rodale Press.
8. Radosevich, S., & Holt, J. (1984). Weed ecology: Implications for vegetation management. Somerset, NJ: John Wiley and Sons, Inc.

***RESOURCES:** (cont.)

9. Klingman, G., Ashton, F., & Noordhoff, L. (1982). Weed science: Principles and practices (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
10. The Interstate Printers and Publishers, Inc. (1987). Weed plants: Color photos and description. Danville, IL: Author.
11. Crop records.
12. Check list - Inspecting crops for pests.

TEACHING ACTIVITIES:

1. Question students on the importance of timely inspection of crops for pests. (* 2,3,4,5,6,8 & 9)
2. Present lecture on the timing of the inspection of plants based on environmental changes (moisture, temperature).
3. Question students on factors that increase the suseptability of the plant to disease (stage of growth/environmental).
4. List parts of the plants that need to be inspected.
5. Question students on things that they would check for when examining each of the listed plant parts.
6. List cultural practices that could account for observed abnormalities. (* 11)
7. Assign students to check for abnormalities on a crop.
8. Show examples of abnormalities found by the students.
9. Question students on the possible causes of the abnormalities found.
10. List resources available to help determine the causes of the abnormalities. (* 1,7 & 10)
11. Assign students to determine the cause of the abnormalities.
12. Assign each student a period of time during which to inspect a crop for pests. (* 12)

CRITERION-REFERENCED MEASURE:

The student must check all parts of the plants for abnormalities, list all abnormalities observed, list possible causes of the abnormality and list the most likely cause of the plant abnormality. All abnormalities listed by the test administrator must be listed by the students, the possible causes must be plausible and the listed most likely cause must be correct.

PERFORMANCE GUIDE:

1. Determine timing of inspection based on environmental/conditions, stage of growth, past pest problems.
2. Check crop for uniformity.
3. Examine the plants for any symptoms that are unusual for particular plant species:
   A. Leaves or needles:
      1. Examine both the new and old leaves and needles.
      2. Examine both top and underside of leaves and needles:
         a. Look for damage.
         b. Check for foreign substances.
         c. Look for insects or other animals.
   B. Stems and trunk:
      1. Look for damage.
      2. Check for foreign substances.
      3. Look for insects and other animals.
   C. Roots:
      1. Look for damage.
      2. Check general condition.
      3. Look for insects and other animals.
   D. Soil:
      1. Inspect area for weeds.
      2. Check drainage conditions.
      3. Look for insects and other animals.
   E. Flowers:
      1. Look for damage.
      2. Check for irregularity in coloration.
      3. Look for insects and other animals.
   F. Fruit:
      1. Look for damage.
      2. Check for irregularities.
      3. Look for insects and other animals.
4. Shake the plant or a branch, if feasible.
5. List all abnormalities observed and the location of the abnormality on the plant.
6. Check plant records for the cultural practices performed on the crop.
7. Identify cause of plant abnormality:
   A. Pests.
   B. Cultural practices.

CHECKLIST

DUTY Growing Plants

TASK Inspect crops for pests.

ENABLER

1. Recall normal appearance of crop.
2. Read crop records.

STUDENT'S NAME____________________ **DATE**__________

EVALUATOR'S NAME____________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to inspect crops for pests.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Checked crop for uniformity.	____	____
2.	Examined both the new and old leaves and needles.	____	____
3.	Examined both top and underside of leaves and needles.	____	____
4.	Looked for damaged leaves and needles.	____	____
5.	Checked for foreign substances on leaves and needles.	____	____
6.	Looked for insects or other animals on leaves and needles.	____	____
7.	Looked for damage on stems and trunks.	____	____
8.	Checked for foreign substances on stems and trunks.	____	____
9.	Looked for insects and other animals on stems and trunks.	____	____
10.	Looked for damage on roots.	____	____
11.	Checked general condition of roots.	____	____
12.	Looked for insects and other animals on roots.	____	____

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
13.	Inspected area for weeds.		
14.	Checked drainage conditions of soil.		
15.	Looked for insects and other animals in the soil.		
16.	Looked for damaged flowers.		
17.	Checked for irregularity in coloration of flowers.		
18.	Looked for insects and other animals on flowers.		
19.	Looked for damaged fruit.		
20.	Checked for irregular fruit.		
21.	Looked for insects and other animals in and/or on fruit.		
22.	Shook the plant or a branch.		
23.	Listed all abnormalities observed including the location of the abnormality.		
24.	Checked plant records.		
25.	Recorded cause(s) of abnormalities.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 96

TASK: Identify insects for insect control.

STANDARD OF PERFORMANCE OF TASK:

Insects and/or insects damage must be identified by name, metamorphic stage, and by type of mouth part.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Insect specimen
Insect identification chart
Plant specimen of insect damage

ENABLING OBJECTIVES:

1. Look up insect in pest control manual or chart.
2. Recall stages of insect life cycle.
3. Recall types of insect mouth parts.
4. Write or print information about insect pests.

***RESOURCES:**

1. Metcalf, R., & Luckmann, W. (1982). Introduction to insect pest management. Somerset, NJ: John Wiley and Sons, Inc.
2. Price, P. (1984). Insect ecology (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
3. Carr, A. (1983). Rodale's color handbook of garden insects. Emmaus, PA: Rodale Press.
4. Yepsen, R., Jr. (1984). The encyclopedia of natural insect and disease control. Emmaus, PA: Rodale Press.
5. Pfadt. (1985). Fundamentals for applied entomology. New York, NY: Macmillan.
6. Price, P. (1984). Insect ecology (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
7. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.

***RESOURCES:** (cont.)

8. Metcalf, C., Flint, W., & Metcalf, R. (1962). *Destructive and useful insects* (4th ed.). Manchester, MO: McGraw-Hill Book Co.
9. Ware, G. (1980). *Complete guide to pest control*. Fresno, CA: Thompson Publications.
10. Ortho Books. (1987). *Controlling lawn and garden insects*. San Francisco, CA: Author.
11. Checklist - Identifying insects for insect control.

TEACHING ACTIVITIES:

1. Question students on the importance of timely identification of insects.
2. List resources available to help identify insect pests. (* 1,2,3,4,5,6,7,8,9 & 10)
3. Present lecture on the importance of determining the current metamorphic stage of the insect pest and the stage that causes danger. (* 1,2,3,4,5,6,7,8,9 & 10)
4. Present lecture on the importance of determining the type of mouth parts that the insect pest has. (* 1,2,3,4,5,6,7,8,9 & 10)
5. Show examples of damaged crops.
6. Assign students to collect a plant specimen of the insect damage.
7. Assign students to collect a specimen of the actual insect.
8. Demonstrate how to identify the insect using an insect identification chart. (* 3)
9. Assign students to determine the metamorphic stage and the type of mouth parts of the insect.
10. Assign each student a crop with insect pest for which to identify the insects for insect control. (* 11)

CRITERION-REFERENCED MEASURE:

The student must obtain specimens of the insect damage and insect, list the part of the plant being damaged, the name of the insect, the current metamorphic stage of the insect, the metamorphic stage during which the insect is most destructive, the metamorphic stage during which the insect is best controlled, and list the type of mouth part. The collected specimens must be adequate for identification of the insect pest, and the listed information must be complete and correct.

PERFORMANCE GUIDE:

1. Collect a plant specimen of the insect damage.
2. Collect a specimen of the actual insect.
3. Identify what part of the plant is being damaged.
4. Use an insect identification chart:
    - A. Match actual insect specimen with the same insect on the chart.
    - B. Match actual plant specimen of insect damage on insect identification chart.
    - C. Identify name of the insect.
5. Recognize the life cycles of specified insect:
    - A. Identify the metamorphic stage of the specified insect.
    - B. Identify the metamorphic stage in which the insect is most destructive.
    - C. Identify the metamorphic stages which respond best to control methods.
6. Identify type of mouth parts particular insect has:
    - A. Piercing-sucking.
    - B. Rasping-sucking.
    - C. Chewing.

CHECKLIST

DUTY Growing Plants

TASK Identify insects for insect control.

ENABLER

1. Look up insect in pest control manual or chart.
2. Recall stages of insect life cycle.
3. Recall types of insect mouth parts.
4. Write or print information about insect pests.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to identify insects for insect control.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Collected a plant specimen of the insect damage.		
2.	Collected a specimen of the actual insect.		
3.	Listed the part of the plant being damaged.		
4.	Matched an actual insect specimen with the same insect on the chart.		
5.	Matched actual plant specimen of insect damage on insect identification chart.		
6.	Listed name of the insect.		
7.	Listed the metamorphic stage of the insect.		
8.	Listed the metamorphic stage in which the insect is most destructive.		
9.	Listed the metamorphic stages which respond best to control methods.		
10.	Listed the type of mouth parts the insect had.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 97

TASK: Identify diseases for disease control.

STANDARD OF PERFORMANCE OF TASK

Diseases must be identified by name and category.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Disease identification chart
Plant specimen of disease damage

ENABLING OBJECTIVES:

1. Look up disease in pest control manual or chart.
2. Recall effects of cultural practices and environmental conditions.
3. Recall categories of diseases.
4. Write or print information about diseases.

***RESOURCES:**

1. Chase, A. (1987). Compendium of ornamental foliage plant diseases. Chicago, IL: American Nurseryman Publishing Co.
2. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
3. Ware, G. (1980). Complete guide to pest control. Fresno, CA: Thompson Publications.
4. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.
5. Yepsen, R., Jr. (1984). The encyclopedia of natural insect and disease control. Emmaus, PA: Rodale Press.
6. Checklist - Identifing diseases for disease control.

TEACHING ACTIVITIES:

1. Question students on the importance of timely identification of diseases.
2. Present lecture on types of diseases.
3. List resources available to help identify a disease. (* 1,2,3,4 & 5)
4. List cultural and environmental information that should be collected when identifying diseases. (* 1,2,3,4 & 5)
5. Show examples of damaged crops.
6. Assign students to collect specimens of the diseased plants.
7. Assign students to list the cultural and environmental information regarding the diseased plants.
8. Assign students to list the possible diseases based on the collected information.
9. Assign students to narrow the list of possible diseases by eliminating those diseases that are least likely based on the collected information.
10. Demonstrate how to match the disease symptom to the symptoms on a disease chart. (* 1)
11. Assign each student a crop with a disease problem for which to identify the disease for disease control. (* 6)

CRITERION-REFERENCED MEASURE:

The student must obtain specimens of the disease damage, list the part of the plant being damaged, list the previous cultural practices, the environmental conditions, and other pertinent information about the plant, list the possible diseases (organism name or abiotic condition), list the reasons why the possible diseases were eliminated from the list of possible causes, and list the name or cause of the disease. The collected specimens must be adequate for identification of the disease, and the listed information must be complete and correct.

PERFORMANCE GUIDE:

1. Identify the plant with the disease symptom.
2. Identify what part of the plant is being damaged.
3. Collect information on cultural practices and previous care:
   - A. Planting depth.
   - B. Irrigation practices.
   - C. Fertilization practices.
   - D. Pruning practices.

PERFORMANCE GUIDE: (cont.)

4. Identify recent weather conditions or environmental conditions.
5. Match disease symptom on plant specimen with disease symptoms on disease identification chart, if possible to determine name of particular disease.
6. Consider all available information concerning the plant.
7. Identify category of disease:
    A. Abiotic disease:
        1. Air pollution.
        2. Salt burn.
        3. Temperature injury:
            a. Cold injury.
            b. Heat injury.
        4. Watering disorders:
            a. Lack of available water.
            b. Excess of available water.
        5. Nutrient disorders:
            a. Nutritional deficiency.
            b. Fertilizer burn.
        6. Chemical damage.
        7. Mechanical damage.
    B. Biotic diseases:
        1. Fungus.
        2. Bacteria.
        3. Virus.
        4. Mycoplasma.

CHECKLIST

DUTY Growing Plants

TASK Identify diseases for disease control.

ENABLER

1. Look up disease in pest control manual or chart.
2. Recall effects of cultural practices and environmental conditions.
3. Recall categories of diseases.
4. Write or print information about diseases.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to identify diseases for disease control.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified a plant specimen with the disease symptoms.	______	______
2. Listed part of the plant being damaged.	______	______
3. Collected information on cultural practices and previous care:		
- Planting depth.	______	______
- Irrigation practices.	______	______
- Fertilization practices.	______	______
- Pruning practices.	______	______
4. Listed recent weather conditions or environmental conditions.	______	______
5. Matched disease symptom on plant specimen with disease symptoms on disease identification chart.	______	______
6. Recorded name of the particular disease.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
7. Identified category of disease.	______	______
8. Listed proper control method.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 98

TASK: Identify weeds for weed control

STANDARD OF PERFORMANCE OF TASK:

Weeds must be identified by name, classification, and severity.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Growing site
Weed specimen
Weed identification chart

ENABLING OBJECTIVES:

1. Define the word weed in horticultural terms.
2. Recall descriptive terminology used to identify plants.

***RESOURCES:**

1. Poincelot, R. (1986). *No-dig, no-weed gardening*. Emmaus, PA: Rodale Press.
2. Page, B., & Thomson, W. (1987) *Insecticide, herbicide, fungicide quick guide*. Fort Atkinson, WI: Nasco.
3. Rice, R., Jr. (1986). *Nursery and landscape weed control manual*. Chicago, IL: American Nurseryman Publishing Co.
4. Radosevich, S., & Holt, J. (1984). *Weed ecology: Implications for vegetation management*. Somerset, NJ: John Wiley and Sons, Inc.
5. Klingman, G., Ashton, F., & Noordhoff, L. (1982).*Weed science: Principles and practices* (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
6. The Interstate Printers and Publishers, Inc. (1987). *Weed plants: Color photos and description*. Danville, IL: Author.
7. Weed identification chart.
8. Checklist - Identifying weeds For weed control.

TEACHING ACTIVITIES:

1. Discuss the importance of timely weed control. (1,2,3,4 & 5)
2. Present lecture on quality and characteristics needed in weed specimen for identification.
3. Present lecture on the importance of correct weed identification.
4. Present lecture on plant characteristics used to classify a specimen as a broadleaf or a grass.
5. Demonstrate the use of a weed identification chart. (* 6 & 7)
6. Assign each student a weed specimen to identify using a weed identification chart. (* 7)
7. List factors that should be considered when determining the severity of a weed problem.
8. Assign each student a site with a weed problem to identify the weeds for weed control. (* 8)

CRITERION-REFERENCED MEASURE:

The student must obtain a sample of the weed, identify the weed species and determine the severity of the weed problem. The genus and species of the weed sample must be recorded (spelling within one letter) along with a qualitative description of the severity of the weed problem.

PERFORMANCE GUIDE:

1. Obtain a weed specimen.
2. Identify the specimen by particular weed classification:
   A. Broadleaf.
   B. Grass.
3. Use weed identification chart:
   A. Match actual weed specimen with the same weed on weed identification chart.
   B. Determine name of the weed.
4. Examine the site where weed was obtained.
5. Identify the severity of weed problem.

CHECKLIST

DUTY Growing Plants

TASK Identify weeds for weed control.

ENABLER

1. Recall descriptive terminology used to identify plants.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to identify weeds for weed control.

PERFORMANCE DETERMINANTS	YES	NO
1. Obtained a representative weed specimen.	______	______
2. Recorded the type of weed (broadleaf or grass).	______	______
3. Recorded the weed's genus and species.	______	______
4. Described the severity of the weed problem.	______	______
5. Cleaned and stored tools.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 99

TASK: Spray plants for pest control.

STANDARD OF PERFORMANCE OF TASK

Pesticide must be mixed and applied according to manufacturer's recommendations and safety precautions. Plants must be sprayed uniformly at specified rate.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Pesticide
Sprayer
Plants
Protective clothing
Warning sign

ENABLING OBJECTIVES:

1. Read pesticide label.
2. Read spraying equipment operating instructions.
3. Evaluate weather conditions.
4. Recall protective clothing to wear when applying toxic chemicals.
5. Recall regulations regarding restricted use pesticides.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.

***RESOURCES:** (cont.)

6. Pesticide label.
7. Spraying equipment operating instructions.
8. Checklist - Spraying plants for pest control.

TEACHING ACTIVITIES:

1. Question students on the possible results of incomplete and/or improper spraying.
2. Present lecture on the level of toxicity of the pesticide to be sprayed. (* 1,2,3,4,5 & 6)
3. Present lecture on the environmental hazards of pesticides.
4. Discuss the importance of applying pesticides according to label directions.
5. Present lecture on the use of spreader stickers.
6. Question students on the protective clothing to wear when spraying plants. (* 1,2,3,4,5 & 6)
7. Questions students on the safety precautions to take to protect others when applying pesticides. (* 1,2,3,4,5 & 6)
8. Present lecture on first aid for accidents involving pesticides.
9. Present lecture on weather conditions that are suitable for applying pesticides. (* 1,2,3,4,5 & 6)
10. Question students on regulations regarding pesticide use.
11. Demonstrate how to a dilute pesticide formulation.
12. Discuss importance of adding pesticides to the the tank in the correct order.
13. Present lecture on spraying equipment selection. (* 1,2,3,4,5 & 6)
14. Demonstrate how to regulate the sprayer pressure. (* 7)
15. Demonstrate how to calibrate the sprayer. (* 7)
16. Demonstrate how to apply the pesticide to the plants.
17. Discuss the importance of uniform application when spraying plants for pest control and advantages of spreader stickers.
18. Discuss the importance of posting warning signs.
19. Demonstrate how to rinse and clean the spraying equipment. (* 7)
20. Present lecture on the proper disposal of left over pesticide solution.
21. Evaluate each student's ability to don protective clothing.

TEACHING ACTIVITIES: (cont.)

22. Question each student on safety precautions they would take to protect others when spraying plants.
23. Assign each student a block of plants to spray for pest control. (* 8)

CRITERION-REFERENCED MEASURE:

The student must read the pesticide label, explain the procedures to be followed (including the safety precautions) to the test administrator, select the spraying equipment, mix the pesticide solution, fill the sprayer, calibrate the sprayer, apply the pesticide, clean and store the sprayer and the safety equipment. Pesticide must be mixed and applied according to manufacturer's recommendations and safety precautions. Plants must be sprayed uniformly at specified rate.

PERFORMANCE GUIDE:

1. Read label of specified pesticide.
   CAUTION: Follow all manufacturer's recommendations and safety precautions. The label will specify whether the pesticide is for general or restricted use. A restricted use pesticide can be used only by certified applicators or by people who are directly supervised by the certified applicator.
2. Check suitability of weather conditions for pesticide application.
3. Wear gloves, goggles, and other recommended protective clothing for specified pesticide.
4. Dilute pesticide formulation to calculated concentration.
   CAUTION: Follow manufacturer's directions for mixing pesticide.
   NOTE: Better results may be obtained by using a spreader sticker.
5. Select spray equipment that will provide uniform coverage:
   A. Sprayer.
   B. Nozzle.
   C. Pressure.
6. Pour diluted pesticide into sprayer.
   CAUTION: Some pesticide formulations must be constantly agitated.

PERFORMANCE GUIDE: (cont.)

7. Regulate sprayer's pressure according to manufacturer's recommendations.
8. Calibrate sprayer.
9. Post signs warning that area is unsafe to enter.
10. Apply pesticide uniformly to plants at specified rate:
    - A. Cover both top and bottom sides of leaves.
    - B. Cover foliage from top to bottom of plant.
11. Rinse sprayer and nozzles upon completion.
12. Remove protective clothing.
13. Wash all exposed areas of skin.
14. Remove signs after required waiting period.

CHECKLIST

DUTY Growing Plants

TASK Spray plants for pest control.

ENABLER

1. Read pesticide label.
2. Evaluate weather conditions.
3. Recall protective clothing to wear when applying toxic chemicals.
4. Recall regulations regarding restricted use pesticides.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME________________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to spray plants for pest control.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Explained the procedures to be followed to spray the plants.	_______	_______
2.	Explained all manufacturer's recommendations and safety precautions.	_______	_______
3.	Explained whether the pesticide is for general or restricted use.	_______	_______
4.	Checked suitability of weather conditions for pesticide application.	_______	_______
5.	Wore gloves, goggles, and other recommended protective clothing for specified pesticide.	_______	_______
6.	Diluted pesticide formulation to calculated concentration.	_______	_______
7.	Followed manufacturer's directions for mixing pesticide.	_______	_______
8.	Poured diluted pesticide into sprayer.	_______	_______
9.	Agitated pesticide formulation.	_______	_______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Regulated sprayer's pressure.	________	________
11. Calibrated sprayer.	________	________
12. Posted signs warning that area is unsafe to enter.	________	________
13. Applied pesticide uniformly to plants at specified rate.	________	________
14. Covered both top and bottom sides of leaves.	________	________
15. Covered foliage from top to bottom of plant.	________	________
16. Disposal of unused pesticide solution.	________	________
17. Rinsed sprayer and nozzles.	________	________
18. Removed protective clothing.	________	________
19. Washed all exposed areas of skin.	________	________
20. Removed signs after required waiting period.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 100

TASK: Calculate pesticide concentrations.

STANDARD OF PERFORMANCE OF TASK:

The recommended concentration calculation must include size of area, amount of plants, and application equipment. The pesticide concentration must contain the manufacturer's recommended percentage of pesticide for specified pest and/or plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop
Pesticide label
Spray equipment

ENABLING OBJECTIVES:

1. Add, subtract, multiply, and/or divide.
2. Read pesticide label.
3. Recall units of measurement (volume/weight/area/speed).
4. Recall characteristics of pesticide application equipment (sprayers).

***RESOURCES:**

1. Haskell, P. (1985). Pesticide application: Principles and practices. New York, NY: Oxford University Press.
2. Ware, G. (1980). Complete guide to pest control. Fresno, CA: Thompson Publications.
3. Ortho Books. (1987). Controlling lawn and garden insects. San Francisco, CA: Author.
4. Pesticide label.
5. Conversion table (volume,weight) English and metric systems.
6. Checklist - Calculate pesticide concentrations.

TEACHING ACTIVITIES:

1. Discuss the importance of applying pesticides at the recommended rate. (* 1,2 & 3)
2. List pests for which the application of a pesticide is recommended. (* 1,2,3 & 4)
3. List pesticides that are recommended for the listed pests. (* 4)
4. Show examples of labels for the listed pesticides. (* 4)
5. Assign students to determine (using the label) the recommended rate at which to apply a listed pesticide for a listed pest. (* 4)
6. Question students on their estimate of the volume of pesticide solution required to treat a given area using given equipment.
7. List resources available to help determine the volume of pesticide solution required for a given area. (* 1,2,3 & 4)
8. List the pesticide, the application rate and the volume of pesticide solution needed for several example pests. (* 1,2,3 & 4)
9. Demonstrate how to convert the listed proportion (carrier:concentrated pesticide) to an amount more in line with the estimated amount of pesticide solution needed by dividing or multiplying both the listed amount of the carrier and the listed amount of the concentrated pesticide solution by the SAME number.
10. Evaluate each student's ability to convert the listed proportion (carrier:concentrated pesticide) to an amount more in line with the estimated amount of pesticide solution needed.
11. Question students on conversions of units of volume and weight within and between the English and metric systems. (* 5)
12. Assign each student a block of plants for which to calculate the amount of pesticide carrier and pesticide concentrate needed to treat the plants. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the amount of carrier required to treat the plants, the type of sprayer to be used, the recommended application rate and the amount of concentrated pesticide required. The listed application rate must be the same as is listed on the pesticide label, the amount of carrier listed must be enough to treat the plants (using the listed sprayer) yet not exceed the

CRITERION-REFERENCED MEASURE: (cont.)

required amount by 10% or one gallon (which ever is greater), and the proportion of carrier to concentrated pesticide must be the same as the recommended proportion (plus or minus 1%).

PERFORMANCE GUIDE:

1. Read label of specified pesticide.
2. Identify the recommended rate for particular pest and crop species from pesticide label.
3. Estimate the size of area and/or amount of plants to be treated.
4. Select application equipment to be used for applying pesticide.
5. Estimate the number of gallons (liters) of pesticide solution needed to cover the area.
6. Identify the amount of pesticide needed to treat the area:
   CAUTION: Follow manufacturer's recommendations for reducing or increasing the amount of pesticide solution to be mixed.
   A. Use the same proportion of pesticide to carrier as recommended in pesticide label:
      1. Convert amount of carrier listed on label's rate to estimated amount of carrier needed.
      2. Convert amount of concentrated pesticide listed on label's rate to an amount that will be proportionate to estimated amount of carrier.

CHECKLIST

DUTY Growing Plants

TASK Calculate pesticide concentrations.

ENABLER

1. Add, subtract, multiply, and/or divide.
2. Read pesticide label.
3. Recall units of measurement (volume/weight).
4. Recall characteristics of pesticide application equipment (sprayers).

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to calculate pesticide concentrations.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified the recommended rate for particular pest and crop species.	____	____
2. Listed the estimated the size of area and/or amount of plants to be treated.	____	____
3. Selected application equipment.	____	____
4. Listed the estimated the number of gallons (liters) of pesticide solution needed.	____	____
5. Recorded the amount of pesticide needed to treat the area.	____	____

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 101

TASK: Drench plants for pest/environmental control.

STANDARD OF PERFORMANCE OF TASK:

The pesticide must be mixed and applied to the soil at the recommended rate and according to manufacturer's recommendations and safety precautions.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Plants
Warning sign
Pesticide label Protective clothing
Application equipment

ENABLING OBJECTIVES:

1. Read pesticide label.
2. Evaluate weather conditions.
3. Recall protective clothing to wear when applying toxic chemicals.
4. Recall regulations regarding restricted use pesticides.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
6. Pesticide/growth regulator label.
7. Checklist - Drenching plants for pest/environmental control.

TEACHING ACTIVITIES:

1. Question students on the possible results of incomplete and/or improper drenching of the plants.
2. Present lecture on the level of toxicity of the pesticide/growth regulator. (* 1,2,3,4,5 & 6)
3. Present lecture on the environmental hazards of pesticides/growth regulators.
4. Discuss the importance of applying pesticides/growth regulator according to label directions.
5. Question students on the protective clothing to wear when drenching plants. (* 1,2,3,4,5 & 6)
6. Questions students on the safety precautions to take to protect others when drenching plants. (* 1,2,3,4,5 & 6)
7. Present lecture on first aid for accidents involving pesticides/growth regulator.
8. Present lecture on weather conditions that are suitable for drenching plants outdoors.
9. Question students on regulations regarding restricted use pesticides.
10. Demonstrate how to dilute pesticide/growth regulator.
11. Discuss the importance of adding pesticide/growth regulators to the tank in the correct order.
12. Demonstrate how to apply the solution to the media.
13. Discuss the importance of uniform application the pesticide/growth regulator.
14. Discuss the importance of posting warning signs.
15. Present lecture on the proper disposal of left over pesticide/growth regulator solution.
16. Demonstrate how to rinse and clean the application equipment. (* 7)
17. Evaluate each student's ability to don protective clothing.
18. Question each student on safety precautions they would take to protect others when drenching plant.
19. Assign each student a block of plants to drench for pest/environmental control. (* 7)

CRITERION-REFERENCED MEASURE:

The student must read the pesticide label, explain the procedures to be followed (including the safety precautions) to the test administrator, mix the drenching solution, apply the pesticide/growth regulator and clean and store the application equipment and the safety equipment. The pesticide must be mixed and applied to the soil at the recommended rate and according to manufacturer's recommendations and safety precautions.

PERFORMANCE GUIDE:

1. Read label of specified growth regulator or pesticide.
   NOTE: Follow all manufacturer's recommendations and safety precautions for application of chemical. The label will specify whether the pesticide is for restricted or general use. A restricted use pesticide can be used only by certified applicators or by people who are directly supervised by the certified applicator.
2. Check suitability of weather conditions for pesticide application.
3. Wear gloves, goggles, and any other protective clothing recommended by manufacturer.
4. Dilute the chemical formulation to the recommended concentration for particular plant species and soil type.
5. Post warning signs in treatment area.
6. Apply chemical solution uniformly to the media at the recommended rate.
   CAUTION: Be careful not to apply any of the chemical to the plants' foliage.
7. Wash application equipment after use.
8. Remove protective clothing.
9. Wash all exposed areas of skin.
10. Remove signs after required waiting period.

CHECKLIST

DUTY Growing Plants

TASK Drench plants for pest/environmental control.

ENABLER

1. Read pesticide label.
2. Evaluate weather conditions.
3. Recall protective clothing to wear when applying toxic chemicals.
4. Recall regulations regarding restricted use pesticides.

STUDENT'S NAME ____________ **DATE** ____________

EVALUATOR'S NAME ____________ **COURSE** ____________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to drench plants for pest/environmental control.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Explained the procedure to be followed to drench the plants.		
2.	Explained all manufacturer's recommendations and safety precautions for application of chemical.		
3.	Explained whether the pesticide is for restricted or general use.		
4.	Checked suitability of weather conditions for pesticide application.		
5.	Wore gloves, goggles, and any other protective clothing recommended by manufacturer.		
6.	Diluted the chemical formulation to the recommended concentration for particular plant species and soil type.		
7.	Posted warning signs in treatment area.		
8.	Applied chemical solution uniformly.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
9.	Applied chemical at recommended rate.	________	________
10.	Avoided application of the chemical to the plants' foliage.	________	________
11.	Disposed of unused pesticide/growth regulator solution.	________	________
12.	Washed application equipment.	________	________
13.	Washed protective clothing.	________	________
14.	Washed all exposed areas of skin.	________	________
15.	Removed signs after required waiting period.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 102

TASK: Fumigate plants for pest control.

STANDARD OF PERFORMANCE OF TASK:

The fumigant must be applied according to manufacturer's recommendations. Protective clothing and respiratory gear must be worn, warning signs placed in treatment area, and all recommended safety precautions observed. Manufacturer's specified treatment and ventilation period must be observed. The fumigated area must be free from the identified pests.

CONDITIONS FOR PERFORMANCE OF TASK:

Fumigant
Respirator
Warning sign
Protective clothing

ENABLING OBJECTIVES:

1. Read pesticide label.
2. Evaluate weather conditions.
3. Recall protective clothing to wear when applying toxic chemicals.
4. Recall regulations regarding restricted use pesticides.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
6. Fumigant label.
7. Checklist - Fumigating plants for pest control.

TEACHING ACTIVITIES:

1. Question students on the possible results of incomplete and/or improper fumigation of plants.
2. Present lecture on the level of toxicity of fumigants. (* 1,2,3,4,5 & 6)
3. Present lecture on the environmental hazards of pesticides.
4. Discuss the importance of using fumigants according to label directions.
5. Question students on the protective clothing to wear when fumigating plants. (* 1,2,3,4,5 & 6)
6. Questions students on the safety precautions to take to protect others when fumigating plants. (* 1,2,3,4,5 & 6)
7. Present lecture on first aid for accidents involving fumigants.
8. Present lecture on weather conditions that are suitable for fumigating plants. (* 1,2,3,4,5 & 6)
9. Question students on regulations regarding restricted use pesticides.
10. Present lecture on calculation of the amount of fumigant needed and spacing of canisters. (* 1,2,3,4,5 & 6)
11. Demonstrate how to seal off an area of plants.
12. Demonstrate how to apply a fumigant.
13. Discuss the importance of posting warning signs.
14. Discuss the importance of ventilating the area at the proper time.
15. Evaluate each student's ability to don protective clothing.
16. Question each student on safety precautions they would take to protect others when fumigating plant.
17. Assign each student a block of plants to fumigate for pest control. (* 7)

CRITERION-REFERENCED MEASURE:

The student must read pesticide label, explain the procedures to be followed (including the safety precautions) to the test administrator, calculate the amount of fumigant needed and the placement of the canisters, seal off the area, apply the fumigant ventilate the area, and clean and store the safety equipment. The fumigant must be applied according to manufacturer's recommendations. Protective clothing and respiratory gear must be worn, warning signs placed in treatment area, and all recommended safety precautions observed. Manufacturer's specified treatment and ventilation period must be observed. The fumigated area must be free from the identified pests.

PERFORMANCE GUIDE:

1. Calculate enclosed area to be treated in cubic feet.
2. Select fumigant to be used.
   CAUTION: Fumigant must be registered to treat the identified pest.
3. Examine the fumigant label.
   CAUTION: Follow all manufacturer's recommendations and safety precautions. The label will specify whether the fumigant is for general or restricted use. A restricted use pesticide can be used only by certified applicators or by people who are directly supervised by the certified applicator. If you do not follow the instructions on the label, you are subject to either civil or criminal penalties.
4. Calculate the amount of fumigant needed and the spacing at which the canisters should be set.
5. Seal off area to be treated.
   CAUTION: Do not apply fumigants in greenhouses on windy days.
   NOTE: Do not use unless plants are well watered and foliage is dry or burning of foliage can occur.
6. Place a warning sign in area warning that fumigation is in progress.
7. Wear protective clothing and respirator/gas mask.
8. Apply fumigant according to manufacturer's recommendations.
   CAUTION: Many fumigants are extremely toxic, so manufacturer's recommendations must be strictly followed.
9. Wash after using fumigant.
10. Leave treated area sealed off for the specified time according to manufacturer's recommendations.
11. Ventilate after the specified time period and before reentry.
12. Remove warning sign from treated area.

CHECKLIST

DUTY Growing Plants

TASK Fumigate plants for pest control.

ENABLER

1. Read pesticide label.
2. Evaluate weather conditions.
3. Recall protective clothing to wear when applying toxic chemicals.
4. Recall regulations regarding restricted use pesticides.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to fumigate plants for pest control.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Calculated enclosed area to be treated in cubic feet.		
2.	Selected fumigant is registered to treat the identified pest.		
3.	Explained procedures to be followed to fumigate the plants.		
4.	Explained all manufacturer's recommendations and safety precautions.		
5.	Explained whether the fumigant is for general or restricted use.		
6.	Calculated the amount of fumigant needed.		
7.	Calculated the spacing at which the canisters should be set.		
8.	Sealed off area to be treated.		
9.	Avoided applying fumigants in greenhouses on a windy day.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
10.	Fumigated plants were well watered.		
11.	Fumigated plants had dry foliage.		
12.	Placed a warning sign in area warning that fumigation was in progress.		
13.	Wore protective clothing and respirator/gas mask.		
14.	Applied fumigant according to manufacturer's recommendations.		
15.	Washed all exposed skin after using fumigant.		
16.	Washed all safety equipment.		
17.	Sealed off the treated area for the specified time according to manufacturer's recommendations.		
18.	Ventilated after the specified time period and before reentry.		
19.	Removed warning sign from treated area.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 103

TASK: Apply granular pesticides.

STANDARD OF PERFORMANCE OF TASK:

Granular pesticides must be broadcast uniformly at recommended rate. Pesticide must be applied according to manufacturer's recommendations and safety precautions.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop
Pesticide
Warning sign
Protective clothing
Pesticide applicator

ENABLING OBJECTIVES:

1. Read pesticide label.
2. Evaluate weather conditions.
3. Recall protective clothing to wear when applying toxic chemicals.
4. Recall regulations regarding restricted use pesticides.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
6. Pesticide label.

***RESOURCES:** (cont.)

7. Granular pesticide application equipment operating instructions.
8. Checklist - Applying granular pesticides.

TEACHING ACTIVITIES:

1. Question students on the possible results of incomplete and/or improper application of granular pesticides.
2. Present lecture on the level of toxicity of granular pesticides. (* 1,2,3,4,5 & 6)
3. Present lecture on the environmental hazards of pesticides.
4. Discuss the importance of applying pesticides according to label directions.
5. Question students on the protective clothing to wear when applying granular pesticides. (* 1,2,3,4,5 & 6)
6. Questions students on the safety precautions to take to protect others when applying granular pesticides. (* 1,2,3,4,5 & 6)
7. Present lecture on first aid for accidents involving granular pesticides.
8. Present lecture on weather conditions that are suitable for application of granular pesticides. (* 1,2,3,4,5 & 6)
9. Question students on regulations regarding restricted use pesticides.
10. Present lecture on selection of granular pesticide application equipment. (* 1,2,3,4,5 & 6)
11. Demonstrate how to calibrate the granular pesticide applicator. (* 7)
12. Demonstrate how to broadcast the granular pesticide. (* 7)
13. Discuss the importance of uniform application of granular pesticides.
14. Discuss the importance of posting warning signs.
15. Present lecture on the proper disposal of left over pesticides.
16. Demonstrate how to rinse and clean the granular pesticide applicator. (* 7)
17. Evaluate each student's ability to don protective clothing.
18. Question each student on safety precautions they would take to protect others when applying granular pesticides.
19. Assign each student a block of plants to which to apply granular pesticides. (* 8)

CRITERION-REFERENCED MEASURE:

The student must read the pesticide label, explain the procedures to be followed (including the safety precautions) to the test administrator, calibrate the granular pesticide applicator, apply the granular pesticide and clean and store the granular pesticide applicator and the safety equipment. Granular pesticides must be broadcast uniformly at the recommended rate. Pesticide must be applied according to manufacturer's recommendations and safety precautions.

PERFORMANCE GUIDE:

1. Read label of specified pesticide.
   CAUTION: Follow all manufacturer's recommendations and safety precautions. The label will specify whether the pesticide is for general or restricted use. A restricted use pesticide can be used only by certified applicators or by people who are directly supervised by the certified applicator.
2. Check suitability of weather conditions for pesticide application.
3. Wear protective clothing recommended by pesticide manufacturer.
4. Post warning signs in treatment area if recommended by pesticide manufacturer.
5. Select applicator.
6. Calibrate applicator:
   - A. Set applicator at recommended setting.
   - B. Determine correct speed to apply chemical.
   - C. Determine correct pattern of application.
   - D. Determine speed and direction of the wind.
7. Broadcast the pesticide uniformly at the recommended rate.
8. Rinse applicator after use.
9. Remove any granular pesticide from the plant foliage by washing or brushing it off.
10. Remove protective clothing.
11. Wash all exposed areas of skin.
12. Remove warning signs from treatment area after required waiting period.

CHECKLIST

DUTY Growing Plants

TASK Apply granular pesticides.

ENABLER

1. Read pesticide label.
2. Evaluate weather conditions.
3. Recall protective clothing to wear when applying toxic chemicals.
4. Recall regulations regarding restricted use pesticides.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to apply granular pesticides.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Explained the procedures to be followed to apply the granular pesticide.	______	______
2.	Explained all manufacturer's recommendations and safety precautions.	______	______
3.	Explained whether the pesticide is for general or restricted use.	______	______
4.	Checked suitability of weather conditions for pesticide application.	______	______
5.	Wore protective clothing recommended by pesticide manufacturer.	______	______
6.	Posted warning signs in treatment area if recommended by pesticide manufacturer.	______	______
7.	Selected applicator.	______	______
8.	Calibrated applicator:		
	- Set applicator at recommended setting.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
8. Calibrated applicator: (cont.)		
- Identified speed to apply chemical.	________	________
- Identified pattern of application.	________	________
- Identified speed and direction of the wind.	________	________
9. Broadcast the pesticide uniformly at the recommended rate.	________	________
10. Disposed of unused pesticide.	________	________
11. Rinsed the applicator after use.	________	________
12. Removed any granular pesticide from the plant foliage by washing or brushing it off.	________	________
13. Washed protective clothing.	________	________
14. Washed all exposed areas of skin.	________	________
15. Removed warning signs from treatment area after required waiting period.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 104

TASK: Control pests biologically.

STANDARD OF PERFORMANCE OF TASK:

The method of pest management must match the type of pest and control the pests' population.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop
Pests
Sprayer
Sterile males
Insect predators
Animal predators
Specified disease
Synthetic sex hormone

ENABLING OBJECTIVES:

1. Identify life cycle of a pest.
2. Recall predator, prey relationship.
3. Look up biological control method in reference book.

***RESOURCES:**

1. Yepsen, R., Jr. (1984). The encyclopedia of natural insect and disease control. Emmaus, PA: Rodale Press.
2. Metcalf, C., Flint, W., & Metcalf, R. (1962). Destructive and useful insects (4th ed.). Manchester, MO: McGraw-Hill Book Co.
3. Ware, G. (1980). Complete guide to pest control. Fresno, CA: Thompson Publications.
4. Price, P. (1984). Insect ecology (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
5. Metcalf, R., & Luckmann, W. (1982). Introduction to insect pest management. Somerset, NJ: John Wiley and Sons, Inc.

***RESOURCES:** (cont.)

6. Kreuter, M. (1985). Macmillan book of organic gardening. New York, NY: Collier Books.
7. Checklist - Controlling pests biologically.

TEACHING ACTIVITIES:

1. Present lecture on the advantages and/or disadvantages of biological control of pests. (* 1,2,3,4,5 & 6)
2. List pests for which biological control is recommended. (* 1,2,3.4,5 & 6)
3. Present lecture on the methods of biological control for the listed pests. (* 1,2,3,4,5 & 6)
4. List resources available to help determine the best method of biological control.
5. Assign each student a pest to control biologically. (* 7)

CRITERION-REFERENCED MEASURE:

The student must list the method of biological control selected and treat the area according to the listed method. The listed method must be the same as is recommended in the reference materials and the pest must be controlled after the treatment.

PERFORMANCE GUIDE:

1. Estimate the size of the area that requires treatment to control specified pest.
2. Select method of biological control for specified pest:
    A. Control pest by introducing natural enemies of the pests:
        1. Introduce insect predators of specified pest.
        2. Introduce animal predators of specified pest.
        3. Introduce disease (fungus) that is a natural enemy of specified pest.
    B. Control pests by interfering with reproduction:
        1. Introduce sterile males of specified species of pest.
        2. Apply synthetic sex hormones to specified pest.

CHECKLIST

DUTY Growing Plants

TASK Control pests biologically.

ENABLER

1. Identify life cycle of a pest.
2. Recall predator, prey relationship.
3. Look up biological control method in reference book.

STUDENT'S NAME____________________ **DATE**__________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to control pest biologically.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Identified the size of the area that requires treatment to control specified pest.	______	______
Introducing natural enemies of the pests:		
2. Introduced insect predators of specified pest.	______	______
3. Introduced animal predators of specified pest.	______	______
4. Introduced disease (fungus) that is a natural enemy of specified pest.	______	______
Interfering with reproduction:		
5. Introduced sterile males of specified species of pest.	______	______
6. Applied synthetic sex hormones to specified pest.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 105

TASK: Control pests mechanically.

STANDARD OF PERFORMANCE OF TASK:

The method of pest management must match the type of pest and control the pests' population.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Site
Nails
Traps
Hammer
Fences
Gloves
Screens
Cultivating equipment

ENABLING OBJECTIVES:

1. Identify pest's mode of transportation.
2. Look up mechanical control method in reference book.
3. Evaluate soil moisture content.
4. Recall cultivation equipment and/or hand tool safety.

***RESOURCES:**

1. Yepsen, R., Jr. (1984). The encyclopedia of natural insect and disease control. Emmaus, PA: Rodale Press.
2. Ware, G. (1980). Complete guide to pest control. Fresno, CA: Thompson Publications.
3. Metcalf, R., & Luckmann, W. (1982). Introduction to insect pest management. Somerset, NJ: John Wiley and Sons, Inc.
4. Kreuter, M. (1985). Macmillan book of organic gardening. New York, NY: Collier Books.

***RESOURCES:** (cont.)

5. Radosevich, S., & Holt, J. (1984). Weed ecology: Implications for vegetation management. Somerset, NJ: John Wiley and Sons, Inc.
6. Klingman, G., Ashton, F., & Noordhoff, L. (1982). Weed science: Principles and practices (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
7. Cultivation equipment operating instructions.
8. Checklist - Controlling pests mechanically.

TEACHING ACTIVITIES:

1. Present lecture on the advantages and/or disadvantages of mechanically controlling pests. (* 1,2,3,4,5 & 6)
2. List pests for which mechanical control is recommended. (* 1,2,3,4,5 & 6)
3. Present lecture on the methods of mechanical control for the listed pests. (* 1,2,3,4,5 & 6)
4. List resources available to help determine the best method of mechanical control.
5. Question students on cultivation equipment and/or hand tool safety. (* 7)
6. Assign each student a pest to control mechanically. (* 8)

CRITERION-REFERENCED MEASURE:

The student must explain the mechanical pest control measures to be taken, and implement the pest control measures. The method of mechanical pest control must match the type of pest. The pests must be controlled after treatment.

PERFORMANCE GUIDE:

1. Estimate the size of the area that requires mechanical treatment to control specified pest.
2. Select method of mechanical control for specified pests:
   A. Control insects or animals by traps:
      NOTE: Traps will not distinguish between beneficial and harmful insects and animals. Follow manufacturer's recommendations and safety precautions when using traps.
      1. Set traps for specified pests.
      2. Check traps periodically for pests.
      3. Remove pests from traps.
      4. Remove traps when pests are under control or when recommended.

PERFORMANCE GUIDE: (cont.)

B. Control insects or animals by barriers:
NOTE: Barriers will not reduce pest population but will restrict it from specified area.
1. Install barriers to prevent pest entry into specified area:
    a. Screens.
    b. Fences.
2. Remove barriers after pests are no longer a threat, if recommended.

C. Control weeds by cultivation:
1. Check soil moisture level to determine its suitability for cultivation.
2. Select the type of cultivation tools and/or equipment.
3. Set cultivation depth.
4. Remove weeds by loosening the soil.
5. Clean equipment up completion.

D. Control weeds, insects or animals by removing them by hand.

CHECKLIST

DUTY Growing Plants

TASK Control pests mechanically.

ENABLER

1. Identify pest's mode of transportation.
2. Look up mechanical control method in reference book.
3. Evaluate soil moisture content.
4. Recall cultivation equipment and/or hand tool safety.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to control pests mechanically.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Estimated the size of the area that requires mechanical treatment to control specified pest.	______	______
2. Explained method of mechanical control for specified pests.	______	______
3. Followed manufacturer's recommendations and safety precautions when using traps.	______	______
4. Set traps for specified pests.	______	______
5. Checked traps periodically for pests.	______	______
6. Removed pests from traps.	______	______
7. Removed traps when pests were under control or when recommended.	______	______
8. Installed barriers to prevent pest entry into specified area.	______	______
9. Removed barriers after pests were no longer a threat.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Checked soil moisture level to determine its suitability for cultivation (for weed control).		
11. Selected the type of cultivation tools and/or equipment.		
12. Set cultivation depth.		
13. Removed weeds by loosening the soil.		
14. Cleaned cultivation equipment after use.		
15. Removed pests by hand.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 106

TASK: Establish plant spacing.

STANDARD OF PERFORMANCE OF TASK:

Plant spacings must reflect market demands, labor requirements, and space allocated for particular plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop
Labor records
Market projections

ENABLING OBJECTIVES:

1. Look up cultural requirements of a crop.
2. Recall effect of close spacing on plants.

*RESOURCES:

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
5. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
6. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
7. Checklist - Establishing plant spacing.

TEACHING ACTIVITIES:

1. Show examples of plants grown at adequate and inadequate spacing.
2. Present lecture on tasks associated with providing adequate spacing. (* 1,2,3,4,5 & 6)
3. List factors to consider when determining quality of plants needed. (* 1,2,3,4,5 & 6)
4. Present lecture on ways to reduce labor costs associated with plant spacing. (* 1,2,3,4,5 & 6)
5. Present lecture on seasonal demands for bench/field space.
6. Present lecture on a hypothetical situation, including information on the crop (species, use of crop), the market demand for the crop, the available space and the cost of labor.
7. Question students on the spacing they would select for the hypothetical situation.
8. Assign each student a crop and growing area for which to establish plant spacing. (* 7)

CRITERION-REFERENCED MEASURE:

The student must list the cultural requirements of the crop, the bench/field space available, the predicted market demand the labor cost and availability, and the plant spacing for the crop. The listed cultural requirements must be the same as listed in the reference materials. The bench/field space available must be described (areas available and dates areas are available). The student must explain the reasons behind the predicted market demands and the listed plant spacing must reflect the market demands, labor requirements, and space available.

PERFORMANCE GUIDE:

1. Identify location where plants will be grown:
   A. Container.
   B. Field.
2. Identify recommended spacings for particular plant species during entire growing season:
   A. First spacing.
   B. Second spacing.
   C. Final spacing.

PERFORMANCE GUIDE: (cont.)

3. Evaluate production techniques:
    - A. Consider quality and cost of plant material demanded by markets.
    - B. Evaluate labor requirements:
        - 1. Available labor.
        - 2. Cost of available labor.
        - 3. Amount of labor required.
    - C. Evaluate available space:
        - 1. Calculate amount of required space for crop:
            - a. First spacing.
            - b. Second spacing.
            - c. Final spacing.
        - 2. Consider space requirements for other crops.
4. Determine whether to eliminate the first and/or second plant spacing and place plants directly at final spacing:
    - A. Weigh market and labor demands with the space available for crop.
    - B. Base the number of spacings used on cost effectiveness and market demands.

CHECKLIST

DUTY Growing Plants

TASK Establish plant spacing.

ENABLER

1. Look up cultural requirements of a crop.
2. Recall effect of close spacing on plants.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to establish plant spacing.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Recorded location where plants will be grown.		
2.	Listed recommended spacings for particular plant species during entire growing season.		
3.	Listed quality and cost of plant material demanded by markets.		
4.	Listed available labor.		
5.	Listed cost of available labor.		
6.	Listed amount of labor required.		
7.	Listed amount of space required for crop:		
	- First spacing.		
	- Second spacing.		
	- Final spacing.		
8.	Listed space requirements for other crops.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
9. Listed advantages and disadvantages of eliminating the first and/or second plant spacing and placing the plants directly at final spacing.	________	________

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 107

TASK: Regulate growing structure temperature.

STANDARD OF PERFORMANCE OF TASK:

Adjustments to heating/cooling system must be made to maintain optimum growing temperature for specified plant species. Thermostats must be set at optimum temperatures and checked by thermometer.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crops
Thermostat
Thermometer
Growing structure

ENABLING OBJECTIVES:

1. Recall fahrenheit and celsius temperature scales.
2. Identify heating and cooling equipment.

***RESOURCES:**

1. Sunset Books. (1976). Greenhouse gardening. Menlo Park, CA: Lane Publishing Co.
2. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
3. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
6. Thermostat instructions.
7. Heating system instructions.
8. Cooling system instructions.
9. Checklist - Regulating growing structure temperature.

TEACHING ACTIVITIES:

1. Present lecture on problems caused by cold temperatures in a growing structure.
2. Present lecture on optimum growing temperature for a particular plant. (* 1,2,3,4 & 5)
3. Present lecture on day time and night time temperatures. (* 1,2,3,4 & 5)
4. Show examples of thermostats and thermometers.
5. Demonstrate how to adjust a thermostat. (* 6)
6. Demonstrate how to manually adjust heating and cooling system. (* 7 & 8)
7. Demonstrate how to position thermometers on the growing structure so direct sunlight will not affect its reading.
8. Question students on thermometer reading.
9. Question students on the accuracy of their thermostat.
10. Discuss the importance of checking the temperature of the growing structure periodically.
11. Assign a student to regulate the temperature of a growing structure for a period of time. (* 9)

CRITERION-REFERENCED MEASURE:

The student must adjust the thermostat(s), manually adjust the heating and cooling system if needed, record the daily high and low temperature of the growing structure, and readjust the thermostat(s) as needed. The temperature of the growing structure must be the same as the optimum growing temperature for the plant species. (plus or minus 5° F).

PERFORMANCE GUIDE:

1. Identify optimum temperatures for particular plant species in growing structures:
    A. Sunny day temperature.
    B. Cloudy day temperature.
    C. Night temperature.
2. Adjust thermostats to desired temperature.
3. Make any manual adjustments to heating or cooling system, if needed:
    A. Adjust side or top ventilators.
    B. Switch fans on/off.
4. Check the accuracy of the thermostats by placing other thermometers in growing structure.
    CAUTION: Thermometer and thermostat must be positioned so direct sunlight will not affect its reading.

PERFORMANCE GUIDE: (cont.)

5. Reset thermostat to adjust for any unexplained discrepancies in temperature reading.
6. Check temperature of growing structures periodically.

CHECKLIST

DUTY Growing plants

TASK Regulate growing structure temperature

ENABLER

1. Recall fahrenheit and celsius temperature scales.
2. Identify heating and cooling equipment.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to regulate growing structure temperature.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Recorded optimum temperatures for plant species.		
2.	Adjusted thermostats to desired temperature.		
3.	Made any manual adjustments to heating or cooling system:		
	- Adjusted side or top ventilators.		
	- Switched fans on/off.		
4.	Checked the accuracy of the thermostats.		
5.	Reset thermostat to adjust for any unexplained discrepancies in temperature reading.		
6.	Checked temperature of growing structures periodically.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 108

TASK: Regulate growing structure humidity.

STANDARD OF PERFORMANCE OF TASK:

The growing structure's relative humidity must meet the optimum level for growth of current crop.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Fog
Mist
Crop
Hygrometer
Heating system
Growing structure
Ventilation system
Sling psychrometer

ENABLING OBJECTIVES:

1. Recall relationship between high relative humidity and condensation.
2. Identify humidity requirements of crop.
3. Regulate growing structure heating and/or cooling systems.
4. Set time clocks for fog system.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.
3. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
5. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.

***RESOURCES:** (cont.)

6. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
7. Checklist - Regulating growing structure humidity.

TEACHING ACTIVITIES:

1. Show areas with high relative humidity and areas with low relative humidity.
2. Present lecture on visual signs of high relative humidity.
3. Present lecture on problems associated with high relative humidity. (* 1,2,3,4,5 & 6)
4. Present lecture on plant propagules which require high relative humidity.
5. Demonstrate how to measure humidity with a sling psychrometer.
6. Demonstrate how to measure humidity with a hygrometer.
7. List procedures used to lower relative humidity. (* 1,2,3,4,5 & 6)
8. List procedures used to raise relative humidity. (* 1,2,3,4,5 & 6)
9. Present lecture on the use of a humidistat.
10. Assign students to regulate the heating and cooling system in the growing structure.
11. Assign each student a period of time during which to regulate the growing structure humidity. (* 7)

CRITERION-REFERENCED MEASURE:

The student must list the crops (plant name and species) in the growing structure, list the humidity requirements of the listed crops, and raise or lower the relative humidity in the growing structure. The list of crops must be complete, the listed humidity requirements must be the same as recommended by the resources materials and the humidity in the growing structure must be optimum for the crop(s).

PERFORMANCE GUIDE:

1. Identify the relative humidity for current crop:
   CAUTION: High humidity may result in condensation of water on crop foliage, which is an ideal environment for many diseases.
   - A. Measure humidity with a sling psychrometer.
   - B. Measure humidity with a hygrometer.
   - C. Use personal observation to determine if humidity level is acceptable.

PERFORMANCE GUIDE: (cont.)

2. Modify relative humidity in growing structure:
    A. Lower relative humidity:
        1. Ventilate the growing structure.
        2. Heat the growing structure.
        3. Ventilate and heat the growing structure concurrently.
        4. Turn off mist or fog system.
    B. Raise relative humidity:
        1. Lower the temperature.
        2. Close vents.
        3. Turn mist system on.
        4. Turn fog system on.

CHECKLIST

DUTY Growing Plants

TASK Regulate growing structure humidity.

ENABLER

1. Recall relationship between high relative humidity and condensation.
2. Identify humidity requirements of crop.
3. Regulate growing structure heating and/or cooling systems.
4. Set time clocks for fog system.

STUDENT'S NAME____________________________**DATE**__________

EVALUATOR'S NAME__________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to regulate growing structure humidity.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed the relative humidity requirement of the current crop.		
2. Measured humidity with a sling psychrometer.		
3. Measured humidity with a hygrometer.		
4. Used personal observation to determine if humidity level was acceptable.		
5. Modified relative humidity in growing structure:		
- Lowered relative humidity.		
- Raised relative humidity.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 109

TASK: Control growing structure light intensity.

STANDARD OF PERFORMANCE OF TASK:

The light intensity of the growing structure on a sunny day must meet the optimum level for growth of specified plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Light meter
Crop manual
Shade cloths
Artificial lighting
Shading compound
Growing structure

ENABLING OBJECTIVES:

1. Recall scale used to measure light intensity (foot candles).
2. Apply and/or remove shading compound.
3. Install and/or remove shade cloth.
4. Install and/or remove light fixtures.

***RESOURCES:**

1. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
2. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
3. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.
4. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
5. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
6. Light meter instructions.
7. Checklist - Controlling growing structure light intensity.

TEACHING ACTIVITIES:

1. Question student's on the scale used to measure light intensity.
2. Present lecture on the importance of optimum light intensity for a particular plant. (* 1,2,3,4 & 5)
3. Present lecture on light intensity during different seasons.
4. Present lecture on why light intensity should be measured on a sunny day.
5. Demonstrate how to measure light intensity. (* 6)
6. Question students on whether the light intensity should be increased or decreased.
7. Monitor students as they practice measuring light intensity. (* 6)
8. Question students on ways to decrease or increase light intensity. (* 1,2,3,4 & 5)
9. Assign students to apply or remove shading compound.
10. Assign students to install or remove shade cloth.
11. Assign students to install or remove light fixtures.
12. Assign students to recheck and record the light intensity measurements.
13. Assign each student a period of time during which to control the growing structure light intensity. (* 7)

CRITERION-REFERENCED MEASURE:

The student must record the light intensity in the growing structure on a sunny day, determine if the light intensity should be increased or decreased and increase or decrease the light intensity. The recorded light intensity measurement must match the light intensity measured by the test administrator (plus or minus 2%) and the light intensity of the growing structure on a sunny day must match the level specified by the test administrator (plus or minus 10%).

PERFORMANCE GUIDE:

1. Identify optimum light intensity for particular plant species in the growing structure.
2. Measure current light intensity on a sunny day.

PERFORMANCE GUIDE: (cont.)

3. Determine if light intensity should be increased or decreased:
    - A. Increase light intensity:
        1. Remove shading compound from growing structure.
        2. Remove/change shade cloth.
        3. Provide plants with artificial light.
    - B. Decrease light intensity:
        1. Add shading compound to growing structure.
        2. Add/change shade cloth.
        3. Remove artificial light from plants.
4. Record light intensity before and after alterations.

CHECKLIST

DUTY Growing Plants

TASK Control growing structure light intensity.

ENABLER

1. Recall scale used to measure light intensity (foot candles).
2. Apply and/or remove shading compound.
3. Install and/or remove shade cloth.
4. Install and/or remove light fixtures.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to control growing structure light intensity.

PERFORMANCE DETERMINANTS	YES	NO
1. Measured light intensity on a sunny day.	______	______
2. Identified if light intensity should be increased or decreased.	______	______
3. Increased light intensity.	______	______
4. Decreased light intensity.	______	______
5. Recorded light intensity before and after alterations.	______	______
6. Matched the light intensity on a sunny day to the pre-determined light intensity need.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 110

TASK: Regulate plants' photoperiod.

STANDARD OF PERFORMANCE OF TASK:

The photoperiod for the current stage of development of a particular plant species must equal the recommended length for optimum plant development.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Timer
Plants
Lights
Black shade cloth

ENABLING OBJECTIVES:

1. Set time clock.
2. Read crop manual and/or crop records.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Larson, R. Introduction to floriculture. Fort Worth, TX: Branch-Smith Publishing.
5. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
6. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.
7. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
8. Checklist - Regulating plants' photoperiod.

TEACHING ACTIVITIES:

1. Question students on the possible results of inadequate regulation of a crop's photoperiod.
2. Present lecture on the purpose of regulating the photoperiod of a crop. (* 1,2,3,4,5,6 & 7)
3. List crops (plant species and purpose of the crop) that require regulation of the photoperiod. (* 1,2,3,4,5,6 & 7)
4. Present lecture on the stages of growth and development during which the plant's photoperiod is regulated. (* 1,2,3,4,5,6 & 7)
5. List resources available to help determine the photoperiods required for a crop. (* 1,2,3,4,5,6 & 7)
6. Assign students to lookup the photoperiod required for the desired plant growth and/or development.
7. Present lecture on seasonally changing day lengths. (* 1,2,3,4,5,6 & 7)
8. Present lecture on artificial light sources. (* 1,2,3,4,5,6 & 7)
9. Present lecture on shade cloth materials. (* 1,2,3,4,5,6 & 7)
10. Present lecture on automatic versus manual shading systems.
11. Present lecture on continuous lighting and cyclic lighting. (* 1,2,3,4,5,6 & 7)
12. Demonstrate how to install a lighting system.
13. Demonstrate how to cover plants with shade cloth.
14. Discuss the importance of avoiding damage to the plants and retaining accessibility to the plants.
15. Present lecture on methods used to avoid heat and/or humidity build up under a shade cloth.
16. Assign a student to set the time clock for the lighting system.
17. Assign each student a period of time during which to regulate the photoperiod of a block of plants. (* 8)

CRITERION-REFERENCED MEASURE:

The student must record the time of day that the plants are to be covered, uncovered, and/or provided with artificial lighting, cover and uncover the plants and set the time clock. The length of the dark period and/or the artificial light must correspond to the recommended photoperiod (plus or minus 15 minutes).

PERFORMANCE GUIDE:

1. Identify photoperiod required for current stage of development of particular plant species.
2. Identify the current natural photoperiod.
3. Adjust photoperiod to match photoperiod requirement of particular plant species:
    - A. Shorten plants' photoperiod:
        1. Cover plants with black shade cloth at specified time in the afternoon/evening.
        2. Remove black shade cloth from plants at specified time in the morning.
    - B. Lengthen plants photoperiod:
        1. Light plants during the middle of the night (night break/lighting), generally from 10:00 p.m. to 2:00 a.m.
           NOTE: Lighting is most effective if it breaks the dark period into two shorter periods.
            - a. Use continuous lighting during night break lighting.
            - b. Use cyclic lighting (light on intermittently for 20% of the time) during night break lighting.

CHECKLIST

DUTY Growing Plants

TASK Regulate plants' photoperiod.

ENABLER

1. Set time clock.
2. Read crop manual and/or crop records.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to regulate plants' photoperiod.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Recorded the photoperiod required for current stage of development of particular plant species.	______	______
2.	Recorded the current natural photoperiod.	______	______
3.	Recorded time of day plants are to be covered and uncovered.	______	______
4.	Recorded time of day plants are to be exposed to artificial light.	______	______
5.	Covered plants with black shade cloth at recorded time.	______	______
6.	Removed black shade cloth from plants at recorded time.	______	______
7.	Exposed plants for artificial light at recorded time.	______	______
8.	Avoided damage to plants when covering and uncovering.	______	______
9.	Avoided heat/humidity build up under shade cloth.	______	______
10.	Avoided hampering access to the plants.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 111

TASK: Remove dead trees and shrubs.

STANDARD OF PERFORMANCE OF TASK:

Dead trees or shrubs must be removed from the growing area. All manufacturer's recommendations and safety precautions must be observed when operating equipment. All dead trees and shrubs must be disposed of according to Environmental Protection Agency approved methods.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Spade
Shovel
Backhoe
Dead tree or shrub
Tractor and log chain
Mechanical tree digger
Tractor with front-endloader

ENABLING OBJECTIVES:

1. Recognize dead trees and shrubs.
2. Recall potential for contamination of healthy plants due to contact with diseased plants.
3. Recall motorized equipment safety.
4. Recall hand tool safety.
5. Lift, carry and lower heavy objects.

***RESOURCES:**

1. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley and Sons, Inc.
2. Yepsen, R., Jr. (1984). The encyclopedia of natural insect and disease control. Emmaus, PA: Rodale Press.
3. Pirone, P. (1978). Disease and pests of ornamental plants (5th ed.). New York, NY: John Wiley and Sons, Inc.

***RESOURCES:** (cont.)

4. Motorized equipment operating instructions.
5. Checklist - Removing dead trees and shrubs.

TEACHING ACTIVITIES:

1. Discuss the importance of the removal of dead trees and shrubs from the growing area. (* 1,2 & 3)
2. Present lecture on disposal methods for plant materials media and containers. (* 1,2 & 3)
3. Show examples of trees and shrubs that appear to be dead.
4. Question students on how they would determine if a tree or shrub is dead.
5. Demonstrate how to cut stem or trunk.
6. Demonstrate how to dig up roots of plant manually.
7. Demonstrate how to dig up roots of plants using motorized equipment. (* 4)
8. Question students on how to lift, carry and lower a heavy object.
9. Assign students to load the dead containerized plants in to a truck/wheel barrow.
10. Assign students to dispose of plant materials.
11. Assign students to dispose of media.
12. Assign students to store containers.
13. Assign each student an area from which to remove the dead trees and shrubs. (* 5)

CRITERION-REFERENCED MEASURE:

The student must tag the trees and shrubs to be removed, verify the condition of the plants with the test administrator, remove the trees and shrubs, and dispose of the plant material, media and containers. All dead trees and shrubs must be tagged, and all plants verified by the test administrator must be removed according to the assigned method, all dead plant material, media and containers must be disposed of in such a way that contamination of the growing area is avoided and all manufacturer's recommendations and safety precautions must be followed.

PERFORMANCE GUIDE:

1. Identify dead trees or shrubs:
   A. Trees and shrubs growing in containers:
      1. Transfer dead tree or shrub, container, and media from growing area.

PERFORMANCE GUIDE: (cont.)

2. Dispose of plant:
    a. Shred bark.
    b. Reuse media in compost or for potting after pasteurization.
3. Reuse container after it has been sanitized, if economical.

B. Trees and shrubs growing in the field:

1. Identify the plant parts that will be removed:
    a. Cut down trunk or stem portion of plant.
    b. Extract entire plant, including roots.
        1. Manually:
            a. Dig up roots of dead plant.
            b. Cut through roots of dead plant, as necessary.
            c. Lift plant from ground.
        2. Mechanically:
            a. Dig tree or shrub roots using a backhoe.
            b. Dig tree or shrub roots using a mechanical tree digger.
            c. Pull tree or shrub from the ground using a tractor and log chain.
            d. Remove tree or shrub from the ground using a tractor and front-endloader.
            NOTE: Follow all manufacturer's recommendations and safety precautions.
        3. Dispose of plants by burning, chipping, or by other Environmental Protection Agency approved methods.

CHECKLIST

DUTY Growing Plants

TASK Remove dead trees and shrubs.

ENABLER

1. Recognize dead trees and shrubs.
2. Recall potential for contamination of healthy plants due to contact with diseased plants.
3. Recall motorized equipment safety.
4. Recall hand tool safety.
5. Lift, carry and lower heavy objects.

STUDENT'S NAME____________________ **DATE**__________

EVALUATOR'S NAME____________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to remove dead trees and shrubs.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Identified dead trees or shrubs.	____	____
2.	Removed dead tree or shrub, container, and media from growing area.	____	____
3.	Disposed of plant.	____	____
4.	Identified the plant parts that will be removed from field grown plants.	____	____
5.	Cut down trunk or stem portion of plant.	____	____
6.	Extracted entire plant.	____	____
7.	Disposed of plants by burning, chipping, or by other Environmental Protection Agency approved methods.	____	____

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 112

TASK: Treat plant wounds.

STANDARD OF PERFORMANCE OF TASK:

Plant wound must be smoothed and rounded.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Tree Maintenance.

CONDITIONS FOR PERFORMANCE OF TASK:

Saw
Knife
Plant (with wound)

ENABLING OBJECTIVES:

1. Recognize damaged plant parts.
2. Recall hand tool safety.
3. Prune plants.
4. Recognize diseased plant parts.

***RESOURCES:**

1. Pirone, P. (1972). Tree maintenance (5th ed.). New York, NY: Oxford University Press.
2. John P., Baumgardt. M., Barrow & Co. Paperback. How to prune almost everything. Fort Atkinson, WI: Nasco.
3. Ortho Books. (1978). All about pruning. San Francisco, CA: Author.
4. Checklist - Treating plant wounds.

TEACHING ACTIVITIES:

1. Show examples of fresh plant wounds, plant wounds that have begun to heal, and plant wounds that have healed completely.
2. Discuss the importance of treating plant wounds immediately after it has been discovered.
3. Present lecture on the counter productive nature of treating plant wounds that have begun to heal.
(* 1,2 & 3)

TEACHING ACTIVITIES: (cont.)

4. Question students on disease susceptibility due to plant wounds.
5. Discuss the importance of removing diseased plant parts. (* 1,2 & 3)
6. Question students on pruning tool and equipment safety.
7. Demonstrate how to treat a plant wound.
8. Assign each student a plant wound to treat. (* 4)

CRITERION-REFERENCED MEASURE:

The student must explain the procedures to be performed to treat the plant wound and treat the plant wound. The plant wound must be smooth and rounded.

PERFORMANCE GUIDE:

1. Smooth over wound area immediately after it has been discovered:
    A. Remove plant stubs.
    B. Re-cut any rough cuts.
    C. Remove loose or injured bark.
    D. Remove any bark or wood that appears to be diseased.
2. Shape wound so it is rounded.

CHECKLIST

DUTY Growing Plants

TASK Treat plant wounds.

ENABLER

1. Recognize damaged plant parts.
2. Recall hand tool safety.
3. Prune plants.
4. Recognize diseased plant parts.

STUDENT'S NAME____________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to treat plant wounds.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Removed plant stubs.		
2.	Re-cut any rough cuts.		
3.	Removed loose or injured bark.		
4.	Removed any bark or wood that appears to be diseased.		
5.	Shaped wound so it is rounded.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 113

TASK: Mow turfgrass.

STANDARD OF PERFORMANCE OF TASK:

The growing tip of turfgrass must exhibit a clean cut after it has been mowed. No more than 1/3 of plant's growing tip should be removed at any one time. Mowing pattern must be varied.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Illinois Lawn Care and Establishment.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Mower
Turfgrass plot

ENABLING OBJECTIVES:

1. Recall mower safety.
2. Measure height of turfgrass.

***RESOURCES:**

1. Conover, H. (1958). Grounds maintenance handbook (3rd ed.). Fort Worth, TX: Branch-Smith Publishing.
2. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment. (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Urbana-Champaign.
3. Daniel, W., & Freeborg, R. (1980). Turf managers' handbook. Cleveland, OH: Harvest.
4. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
5. Checklist - Mowing turfgrass.

TEACHING ACTIVITIES:

1. Discuss the importance of safety regarding the mower operator, the general public, the mowing equipment, and for the turfgrass species. (* 1,2,3 & 4)
2. Present lecture on determining mowing height. (* 1,2,3 & 4)
3. Present lecture on determining when to mow the turfgrass. (* 1,2,3 & 4)
4. Discuss the importance of blade sharpness.
5. Present lecture on the importance of varying the mowing pattern. (* 1,2,3 & 4)
6. Present lecture on calculation of mowing frequency. (* 1,2,3 & 4)
7. Question students regarding mower safety.
8. Demonstrate how to select the mowing pattern.
9. Demonstrate how to check the mower blade for sharpness.
10. Demonstrate how to perform the initial check of the mower's height adjustment.
11. Demonstrate how to reset the mowing height.
12. Demonstrate how to start the mower.
13. Assign students to mow a short strip of turfgrass.
14. Demonstrate how to check the actual mowing height (check height of turfgrass within short strip just mowed).
15. Monitor students as they check the mower height.
16. Monitor students as they practice starting the mower.
17. Monitor students as they practice mowing using a pattern.
18. Assign each student an area of turfgrass to mow. (* 5)

CRITERION-REFERENCED MEASURE:

The student must determine the mowing pattern, check the blade sharpness, check and set the mower height, and mow the turfgrass. The mowed turfgrass must exhibit a clean cut at the target mowing height (plus or minus 10%) (cut end of blade without fibers beyond the mowing height).

PERFORMANCE GUIDE:

1. Identify mowing height recommended for particular turfgrass species.
2. Check mower blade for sharpness:
   A. Sharpen dull or nicked blades.
   B. Replace worn blades.

PERFORMANCE GUIDE: (cont.)

3. Check mower for recommended mowing height for particular plant species.
   NOTE: To insure an accurate setting, mowing heights must be checked and adjusted on turfgrass area.
4. Identify mowing frequency:
   NOTE: Mowing frequency is dependent on the growth rate of turfgrass.
   A. Remove no more than 1/3 of plant when mowed.
   B. Mow turfgrass when plants reach a height of 50% greater than cutting height.
      NOTE: Optimal height of grass at time of mowing is calculated by the following formulas:
      Mowing Height divided by 2 = T
      T + Mowing Height = Optimum Height of grass at mowing time.
   C. Cut turfgrass frequently enough so optimum height is maintained and no more than 1/3 of the top growth is removed at any one time.
5. Cut turfgrass using specified equipment:
   A. Follow manufacturer's recommendations and safety precautions when operating equipment.
   B. Vary mowing pattern each time the turfgrass is mowed.

CHECKLIST

DUTY Growing Plants

TASK Mow turfgrass.

ENABLER

1. Recall mower safety.
2. Measure height of turfgrass.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to mow turfgrass.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Wore long trousers.		
2.	Wore leather boots.		
3.	Wore safety goggles		
4.	Checked mower blade.		
5.	Checked mower's height adjustment.		
6.	Adjusted mowing height.		
7.	Checked fuel level.		
8.	Checked oil level.		
9.	Checked air filter.		
10.	Started the mower.		
11.	Mowed a short strip.		
12.	Checked actual mowing height.		
13.	Adjusted and rechecked mowing height.		
14.	Mowed turfgrass using a pattern.		
15.	Shut down the mower.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 114

TASK: Roll sod.

STANDARD OF PERFORMANCE OF TASK:

Uprooted turfgrass roots must be pressed back in contact with dry soil by rolling. Manufacturer's recommendations and safety precautions must be observed. Rolling pattern must not overlap.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Roller
Turfgrass site

ENABLING OBJECTIVES:

1. Recall definition of heaved and uprooted.
2. Determine if roller has pressed turfgrass roots back in contact with the soil.

***RESOURCES:**

1. Conover, H. (1958). Grounds maintenance handbook (3rd ed.). Fort Worth, TX: Branch-Smith Publishing.
2. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment. (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Urbana-Champaign.
3. Turgeon, A. (1980). Turf grass management. Reston, VA: Reston.
4. Daniel, W., & Freeborg, R. (1980). Turf managers' handbook. Cleveland, OH: Harvest.
5. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
6. Checklist - Rolling sod.

TEACHING ACTIVITIES:

1. Present lecture on reasons for rolling sod. (* 1, 2,3,4 & 5)
2. Outline procedure used to roll sod. (* 1,2,3,4 & 5)
3. Discuss the importance of not overlapping the pattern when rolling sod.
4. Question students on the problems associated with rolling sod when the soil is excessively wet.
5. Present lecture on the range of soil moisture content that is allowable for rolling sod.
6. Present lecture on the minimum soil moisture content that is allowable without irrigation of the sod after rolling.
7. Show turfgrass plants that are heaved or uprooted.
8. Evaluate the student's ability to identify turfgrass plants that are heaved or uprooted.
9. Demonstrate how to check soil moisture content.
10. Present lecture on roller safety.
11. Demonstrate how to adjust the weight of the roller.
12. Demonstrate how to use the roller to press heaved and uprooted turfgrass roots back in contact with the soil.
13. Evaluate the student's ability to determine if the roller has pressed the turfgrass roots back in contact with the soil.
14. Monitor students as they practice adjusting the weight of the roller.
15. Monitor students as they practice rolling sod.
16. Assign each student an area of sod to roll. (* 6)

CRITERION-REFERENCED MEASURE:

The student must determine if the soil moisture content is within the allowable range for rolling the sod, adjust the weight of the roller and use the roller to press the turfgrass roots back in contact with the soil without overlapping the rolling pattern and determine if the rolled area needs irrigation. The turfgrass plants must be pressed back in contact with the soil (roots adhere to the soil) and the assigned area must have no visibly heaved or uprooted turfgrass plants.

PERFORMANCE GUIDE:

1. Inspect site to determine if turfgrass plants are heaved or uprooted from soil.
2. Check soil moisture level at site.

PERFORMANCE GUIDE: (cont.)

3. Press turfgrass roots back in contact with soil with roller:
   - A. Adjust weight of roller if necessary.
   - B. Move roller over entire site.

   CAUTION: Follow manufacturer's instructions and safety precautions when operating roller.
4. Irrigate site if soil is very dry.

CHECKLIST

DUTY Growing Plants

TASK Roll sod.

ENABLER

1. Determine if roller has pressed turfgrass roots back in contact with the soil.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to roll sod.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Checked the moisture content of the soil.		
2.	Adjusted the weight of the roller.		
3.	Used a pattern to roll the sod.		
4.	Avoided overlapping the pattern.		
5.	Checked for turfgrass plants that were not pressed back into contact with the soil.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 115

TASK: Renovate turf.

STANDARD OF PERFORMANCE OF TASK:

The site to be renovated must be sprayed with a herbicide. Manufacturer's recommendations and safety precautions must be observed during application and the waiting period. The specified turfgrass must be planted during the recommended season at the recommended rate. The site must be irrigated as needed until turfgrass is established.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Rake
Site
Turfgrass seed
Herbicide
Overseeder or diskseeder
Vertical mower

ENABLING OBJECTIVES:

1. Recall factors to consider when selecting turfgrass species.
2. Apply herbicides.
3. Cultivate turf.
4. Irrigate turf.

***RESOURCES**

1. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
2. Sunset Books. (1979). Lawns & ground covers. Menlo Park, CA: Lane Publishing Co.
3. MacCaskey, M. (1982). Lawns and Ground Covers: How to select, grow, and enjoy. Tucson, AZ: HP Books.
4. Ashton, F., & Crafts, A. (1981). Modes of action of herbicides (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.

***RESOURCES:** (cont.)

5. Page, B., & Thomson, W. (1987) Insecticide, herbicide, fungicide quick guide. Fort Atkinson, WI: Nasco.
6. Overseeder or diskseeder operating instructions.
7. Checklist - Renovating turf.

TEACHING ACTIVITIES:

1. Outline steps used to renovate turf.
2. Present lecture on determining seeding rate. (* 1,2 & 3)
3. Present lecture on calibrating seeding equipment. (* 1,2 3 & 6)
4. Present lecture on the season(s) of the year most suitable for seeding. (* 1,2 & 3)
5. Question students on application of herbicide safety. (* 4 & 5)
6. Show examples of turf that needs renovation.
7. Assign students to apply a herbicide to the turf.
8. Question students on cultivation equipment safety.
9. Assign students to cultivate an area of the turf.
10. Demonstrate how to rake the thatch loosened by the cultivator.
11. Demonstrate how to replant the cultivated area using an overseeder or diskseeder. (* 6)
12. Assign students to irrigate the seeded area.
13. Monitor students as they practice renovating turf.
14. Assign each student an area of turf to renovate. (* 7)

CRITERION-REFERENCED MEASURE:

The student must calculate the seeding rate, cultivate the turf, rake the thatch, sow the seed and irrigate as needed until the plants are established. The calculated seeding rate must provide viable seeds at the recommended rate (plus or minus 3%) and plants must become established at the site of the renovated turf.

PERFORMANCE GUIDE:

1. Identify the particular turf species or cultivar that will be replanted.
2. Identify the recommended seeding rate for the specific species of turfgrass planted.
3. Plan renovation for suitable season of year, generally late summer, early fall, or early spring.

PERFORMANCE GUIDE: (cont.)

4. Spray the site to be renovated with a herbicide to kill present vegetation.
   CAUTION: Manufacturer's recommendations and safety precautions must be observed.
5. Follow manufacturer's recommended waiting time, generally at least 7 days, before replanting.
6. Replant site with turfgrass:
   A. Use an overseeder or diskseeder to replant site.
      CAUTION: Manufacturer's recommendations and safety precautions must be observed.
   B. Apply 1/2 of the seed in an east-west direction and 1/2 in a north-south direction, for even distribution.
7. Rake any thatch loosened by the vertical mower blades on the overseeder.
   NOTE: Seed must be in close contact with soil to receive moisture and germinate.
8. Irrigate the turfgrass:
   A. Irrigate frequently until the turfgrass seed has germinated.
   B. Reduce frequency of irrigation after turfgrass seed has germinated but continue to irrigate until turfgrass is established.

CHECKLIST

DUTY Growing Plants

TASK Renovate turf.

ENABLER

1. Apply herbicides.
2. Cultivate turf.
3. Irrigate turf.

STUDENT'S NAME ______________________ **DATE** __________

EVALUATOR'S NAME ______________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to renovate turf.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Calculated the seeding rate.		
2.	Applied herbicide safely.		
3.	Waited long enough after herbicide before replanting.		
4.	Raked any thatch loosened by the vertical mower blades on the overseeder.		
5.	Used an overseeder or diskseeder to replant the site.		
6.	Applied 1/2 of the seed in an east-west direction and 1/2 in a north-south direction.		
7.	Irrigated the turfgrass.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 116

TASK: Reseed worn spots on turf.

STANDARD OF PERFORMANCE OF TASK:

Any existing grass on worn spot must be closely mowed to a height of 1/2 inch. The specified turfgrass must be planted during the recommended season at the recommended seeding rate. The site must be irrigated as needed until new plants are established.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Illinois Lawn Care and Establishment.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Rake
Roller
Drag mat
Turfgrass seed
Vertical mower
Core cultivator
Broadleaf herbicide
Overseeder or diskseeder
Turf site with worn spots

ENABLING OBJECTIVES:

1. Recall factors to consider when selecting turfgrass species.
2. Apply herbicides.
3. Mow turfgrass.
4. Cultivate turfgrass.
5. Irrigate turfgrass.

***RESOURCES:**

1. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
2. Sunset Books. (1979). Lawns & ground covers. Menlo Park, CA: Lane Publishing Co.

***RESOURCES:** (cont.)

3. MacCaskey, M. (1982). Lawns and Ground Covers: How to select, grow, and enjoy. Tucson, AZ: HP Books.
4. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Champaign-Urbana.
5. Ashton, F., & Crafts, A. (1981). Modes of action of herbicides (2nd ed.). Somerset, NJ: John Wiley and Sons, Inc.
6. Page, B., & Thomson, W. (1987) Insecticide, herbicide, fungicide quick guide. Fort Atkinson, WI: Nasco.
7. Overseeder or diskseeder operating instructions.
8. Checklist - Reseeding worn spots on turf.

TEACHING ACTIVITIES:

1. Outline steps used to reseed worn spot on turf.
2. Present lecture on selection of the turfgrass species or cultivar. (* 1, 2,3 & 4)
3. Present lecture on calculating seed rates.
4. Present lecture on the season of the year most suitable for seeding. (* 1, 2,3 & 4)
5. Question students on application of broadleaf herbicide safety. (* 5 & 6)
6. Show example of worn spots in turfgrass.
7. Question students on mower safety.
8. Assign students to mow a worn spot.
9. Question students on the purpose of mowing the worn spot before sowing the seed.
10. Question students on cultivation equipment safety.
11. Assign students to cultivate a worn spot.
12. Demonstrate how to sow the seed by hand.
13. Demonstrate how to sow seed using a overseed or diskseeder. (* 7)
14. Assign students to irrigate the seeded area.
15. Monitor students as they practice reseeding worn spots.
16. Assign each student a worn spot to reseed. (* 8)

CRITERION-REFERENCED MEASURE:

The student must calculate the seeding rate, mow the worn spot, sow the seed and irrigate as needed until the plants are established. The calculated seeding rate must provide viable seeds at the recommended rate (plus or minus 3%) and plants must become established at the site of the worn spot.

PERFORMANCE GUIDE:

1. Identify the particular turf species or cultivar that will be replanted.
2. Identify the recommended seeding rate for the specific turfgrass planted.
3. Plan reseeding for suitable season of the year, generally late summer, early fall, or early spring.
4. Treat worn spots with broadleaf herbicide if broadleaf weeds are a problem:
    - A. Apply broadleaf herbicide.
      CAUTION: Follow manufacturer's recommendations and safety precautions.
    - B. Apply early enough to provide the allotted waiting period before planting time.
5. Set lawn mower blade at its lowest setting.
6. Mow existing grass to a low height, approximately 1/2 inch.
7. Sow seed in the worn spot area:
   NOTE: Seed must be in close contact with soil particles.
    - A. Mechanically:
        1. Apply seed using a diskseeder or overseeder.
        2. Apply 1/2 of the seed in an east-west direction and 1/2 in a north-south direction, for even distribution.
    - B. Seeding by hand:
        1. Cultivate worn area using a core cultivator or vertical mower several times.
        2. Use vertical mower or drag mat to break up extracted soil plugs.
           NOTE: Small areas may be dug by hand.
        3. Seed area at a heavy rate.
        4. Rake seed in soil.
        5. Roll area lightly.
        6. Top dress area, if possible.
        8. Irrigate as needed until new plants are well established.

CHECKLIST

DUTY Growing Plants

TASK Reseed worn spots on turf.

ENABLER

1. Apply herbicides.
2. Mow turfgrass.
3. Cultivate turfgrass.
4. Irrigate turfgrass.

STUDENT'S NAME________________________ **DATE**__________

EVALUATOR'S NAME________________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to reseed worn spots on turf.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Calculated the seeding rate.	______	______
2.	Applied herbicide safety.	______	______
3.	Waited long enough after herbicide treatment before replanting.	______	______
4.	Set mower blade at its lowest setting.	______	______
5.	Mowed existing grass.	______	______
6.	Cultivated worn area using a core cultivator or vertical mower.	______	______
7.	Used vertical mower or drag mat to break up extracted soil plugs.	______	______
8.	Raked seed into soil.	______	______
9.	Rolled area.	______	______
10.	Applied 1/2 of the seed in an east-west direction and 1/2 in a north-south direction.	______	______
11.	Irrigated the site.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 117

TASK: Regulate carbon dioxide in a greenhouse.

STANDARD OF PERFORMANCE OF TASK:

Carbon dioxide levels inside the greenhouse must be regulated at 300 parts per million by air circulation or ventilation. Carbon dioxide burners or injectors must be used to regulate carbon dioxide levels at 1000-1500 parts per million.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Crop
Greenhouse
Carbon dioxide injector
Carbon dioxide burner

ENABLING OBJECTIVES:

1. Recall carbon dioxide's role in photosynthesis.
2. Recall how to operate greenhouse air circulation and ventilation equipment.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.
5. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
6. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.

***RESOURCES:** (cont.)

7. Carbon dioxide injection operating instructions.
8. Carbon dioxide burner operating instructions.
9. Checklist - Regulating carbon dioxide in a greenhouse.

TEACHING ACTIVITIES:

1. Question students on the role of carbon dioxide in photosynthesis. (* 1,2,3,4,5 & 6)
2. Present lecture on the level of carbon dioxide needed for plant growth. (* 1,2,3,4,5 & 6)
3. Present lecture on the lower carbon dioxide levels due to a sealed greenhouse during winter months. (* 1,2,3,4,5 & 6)
4. Present lecture on the hazards of carbon dioxide to humans and plants. (* 7 & 8)
5. List methods used to increase the carbon dioxide level inside the greenhouse. (* 1,2,3,4,5 & 6)
6. Present lecture on the time of day that carbon dioxide enrichment is most beneficial to plants.
7. Question students on operation of greenhouse circulation and ventilation equipment.
8. Demonstrate the operation of a carbon dioxide injector and/or carbon dioxide burner. (* 7 & 8)
9. Discuss the importance of complete combustion when using a carbon dioxide burner.
10. Assign each student a period of time during which to regulate carbon dioxide in a greenhouse. (* 9)

CRITERION-REFERENCED MEASURE:

The student must regulate the carbon dioxide level in the greenhouse at 300 parts per million by air circulation or ventilation and/or operate carbon dioxide burners or injectors to regulate the carbon dioxide level at 1000-4500 parts per million.

PERFORMANCE GUIDE:

1. Identify the level of carbon dioxide needed for plant growth:
    A. Consider the light intensity the crop is receiving.
    B. Consider whether the greenhouse will be ventilated on specified day.

PERFORMANCE GUIDE: (cont.)

2. Increase carbon dioxide available to crop inside the greenhouse:
    A. Circulate greenhouse air during daylight hours.
    B. Ventilate greenhouse during daylight hours when weather conditions permit.
    C. Enrich carbon dioxide inside the greenhouse during daylight hours to a level of approximately 1000- 1500 parts per million, according to recommendations for particular plant species.

       NOTE: Carbon dioxide enrichment can be required during winter months when greenhouse ventilation is minimal.

       CAUTION: High concentrations of carbon dioxide are hazardous to human and plant health. Follow manufacturer's recommendations and safety precautions when using carbon dioxide enrichment systems.
        1. Inject pure manufactured carbon dioxide gas into the greenhouse.
        2. Burn hydrocarbons to produce carbon dioxide for greenhouse.
3. Record the level of carbon dioxide in the greenhouse.

CHECKLIST

DUTY Growing Plants

TASK Regulate carbon dioxide in a greenhouse.

ENABLER

1. Recall how to operate greenhouse air circulation and ventilation equipment.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to regulate carbon dioxide in a greenhouse.

PERFORMANCE DETERMINANTS	YES	NO
1. Circulated greenhouse air during daylight hours.	______	______
2. Ventilated greenhouse during daylight hours when weather conditions permit.	______	______
3. Enriched carbon dioxide inside the greenhouse during daylight hours.	______	______
4. Injected pure manufactured carbon dioxide gas into the greenhouse.	______	______
5. Burned hydrocarbons to produce carbon dioxide for greenhouse.	______	______
6. Followed manufacturer's recommendations and safety precautions when using carbon dioxide enrichment systems.	______	______
7. Recorded the level of carbon dioxide.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 118

TASK: Apply growth regulator to crops.

STANDARD OF PERFORMANCE OF TASK:

The growth regulator for particular plant species must be applied following manufacturer's recommendations. Growth regulator must be applied at a uniform rate.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Sprayer
Respirator
Watering can
Growth regulator
Protective clothing
Plants (must require growth regulator treatment)

ENABLING OBJECTIVES:

1. Mix horticultural chemicals for application as spray or drench.
2. Apply horticultural chemicals as spray or drench.

***RESOURCES:**

1. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
2. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers & Publishers, Inc.
3. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
5. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
6. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.

***RESOURCES:** (cont.)

7. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
8. Greenhouse supply catalog.
9. Growth regulator label.
10. Checklist - Applying growth regulators to crops.

TEACHING ACTIVITIES:

1. Present lecture on the purpose(s) of treating plants with a growth regulator. (* 1,2,3,4,5,6 & 7)
2. List crops (plant species and purpose of crop) that require application of a growth regulator. (* 1,2,3,4,5,6 & 7)
3. Present lecture on the stage of growth that growth regulators are applied. (* 1,2,3,4,5,6 & 7)
4. List growth regulators that are available. (* 8)
5. List methods used to apply growth regulators. (* 1,2,3,4,5,6 & 7)
6. Show examples of growth regulator labels. (* 9)
7. Assign students to list the plant from growth regulator label, for which the growth regulator is registered. (* 9)
8. List environmental conditions required for optimal results from the growth regulator application. (* 1,2,3,4,5,6,7 & 9)
9. Discuss the importance of applying the growth regulator uniformly.
10. Question students on how to mix horticultural chemicals.
11. Question students on application of horticultural chemicals.
12. Assign each student a plant for which to apply a growth regulator plants. (* 10)

CRITERION-REFERENCED MEASURE:

The student must select the growth regulator for the crop, select the stage of growth to apply the growth regulator, mix and apply the growth regulator. The growth regulator selected must be registered for the plant species, applied uniformly (plants respond uniformly) applied according to the manufacturer's recommendations and applied during favorable environmental conditions.

PERFORMANCE GUIDE:

1. Select plants that require a growth regulator to maintain optimum plant size.
2. Select type of growth regulator to use for particular plant species.
   CAUTION: Make sure growth regulator is registered for particular plant species being treated.
3. Wear protective clothing and respirator recommended by manufacturer.
4. Make a dilute growth regulator solution at manufacturer's recommended rate.
5. Treat plants with growth regulator following manufacturer's recommendations and safety precautions.
   NOTE: Most growth regulators are applied as a foliar spray or a soil drench. Favorable environmental conditions are necessary for optimal results.
   CAUTION: Growth regulator must be applied uniformly at specified rate on plant and crop to produce uniform growth and desired results.
6. Wash all exposed areas of skin after applying growth regulator.

CHECKLIST

DUTY Growing Plants

TASK Apply growth regulator to crops.

ENABLER

1. Mix horticultural chemicals for application as spray or drench.
2. Apply horticultural chemicals as spray or drench.

STUDENT'S NAME ______________________ **DATE** __________

EVALUATOR'S NAME ______________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to apply growth regulator to crops.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected a growth regulator that is registered for the crop.	______	______
3.	Wore protective clothing and respirator.	______	______
4.	Made a dilute growth regulator solution at manufacturer's recommended rate.	______	______
5.	Applied growth regulator safety.	______	______
6.	Washed all exposed areas of skin after applying the growth regulator.	______	______

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 119

TASK: Plant bulbs, corms, tubers, and tuberous roots.

STANDARD OF PERFORMANCE OF TASK:

Bulbs, corms, tubers, and tuberous roots must be planted at specified planting time, depth and spacing for particular plant species. Bulbs, corms, tubers, and tuberous roots must be planted right side up.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Holland Bulb Forcer's Guide.

CONDITIONS FOR PERFORMANCE OF TASK:

Bulbs
Corms
Shovel
Trowel
Tubers
Tuberous roots
Pasteurized media
Sanitized bulb pan
Holland Bulb Forcer's Guide

ENABLING OBJECTIVES:

1. Recall vegetative reproductive structures of plants.
2. Look up planting recommendations.
3. Measure distance (inches/feet).
4. Irrigate plants.
5. Mulch plants.

***RESOURCES:**

1. DeHertogh, A. (1985). Holland bulb forcer's guide (3rd ed.). Hillegom, Netherlands: International Flower-Bulb Centre.
2. Ortho Books. (1986). All about bulbs. San Francisco, CA: Author.
3. Sunset Books. (1985). Bulbs for all seasons. Menlo Park, CA: Lane Publishing Co.

***RESOURCES:** (cont.)

4. Scott, G. (1982). Bulbs: How to select, grow and enjoy. Tucson, AZ: HP Books.
5. Checklist - Planting bulbs, corms, tubers, and tuberous roots.

TEACHING ACTIVITIES:

1. Outline procedures used to plant bulbs, corms tubers, and tuberous roots.
2. Question students on vegetative reproduction in plants.
3. Show examples of plant parts ready to be planted.
4. Show example of plant parts that have grown.
5. List resources available to help determine planting procedures. (* 1,2,3 & 4)
6. Assign students to look up time, depth and spacing recommended for a particular vegetative reproductive plant part.
7. Demonstrate how to plant bulbs, corms, tubers, and tuberous roots.
8. Discuss the importance of rodent protection.
9. Assign students to plant bulbs, corms, tubers, and tuberous roots. (* 5)

CRITERION-REFERENCED MEASURE:

The student must determine and list the planting date, planting depth and spacing, plant the bulbs, corms, tubers or tuberous roots and provide for their environmental care. The listed information must be the same as is listed in the resource materials, the bulbs, corms, tubers, and tuberous roots must be planted right side up and all environmental requirements must be provided.

PERFORMANCE GUIDE:

1. Select variety of bulbs, corms, tubers, or tuberous roots to be planted.
2. Identify the recommended planting time for each variety.
3. Prepare media for planting.
4. Identify recommended spacing for each species.
5. Identify depth for planting each species.
   NOTE: Generally bulbs are planted at a depth of three times their width.
6. Dig hole in bed or bulb pan at proper depth for particular species.

PERFORMANCE GUIDE: (cont.)

7. Place bulbs, corms, tubers, or tuberous roots (right side up) in hole.
   NOTE: Some specialized stems planted in outdoor beds may require rodent protection.
8. Fill hole with media.
9. Irrigate the bulbs, corms, tubers, or tuberous roots.
10. Provide suitable temperature for particular plant species:
    A. Mulch beds in which bulbs, corms, tubers, or tuberous roots are planted.
    B. Move bulb pans with planted bulbs, corms, tubers, or tuberous roots to an area with temperatures suitable for growing or forcing.

CHECKLIST

DUTY Growing Plants

TASK Plant bulbs, corms, tubers, and tuberous roots.

ENABLER

1. Recall vegetative reproductive structures of plants.
2. Look up planting recommendations.
3. Measure distance (inches/feet).
4. Irrigate plants.
5. Mulch plants.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plant bulbs, corms, tubers, and tuberous roots.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Listed planting time.		
2.	Prepared media for planting.		
3.	Listed spacing for particular species.		
4.	Listed depth for planting particular species.		
5.	Dug hole in bed or bulb pan.		
6.	Placed bulbs, corms, tubers, or tuberous roots in hole.		
7.	Filled hole with media.		
8.	Irrigated the bulbs, corms, tubers, or tuberous roots if needed.		
9.	Provided suitable temperature for particular plant species.		

DUTY: GROWING PLANTS

PERFORMANCE OBJECTIVE NO. 120

TASK: Plant grass stolons, sprigs, and plugs.

STANDARD OF PERFORMANCE OF TASK:

Turfgrass stolons, sprigs, and plugs must be planted at recommended depth and spacing for particular plant species. The medium must be firmed and make close contact with the stolons, sprigs, and plugs. The planting site must be kept moist until roots are established.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Illinois Lawn Care and Establishment.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Hoe
Plugs
Sprigs
Roller
Sod pluggers
Planting site
Sprigging tool
Mechanical planters

ENABLING OBJECTIVES:

1. Recall vegetative parts of turf grass plants.
2. Evaluate soil moisture content.
3. Irrigate turf.
4. Measure distance (inches/feet).
5. Calculate square feet.

***RESOURCES:**

1. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Urbana-Champaign.
2. Turgeon, Alfred, J. (1980). Turf grass management. Reston, VA: Reston.

***RESOURCES:** (cont.)

3. Daniel, W., H., & Freeborg, R., P. (1980). Turf managers' handbook. Cleveland, OH: Harvest.
4. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
5. Beard, J. (1972). Turfgrass: Science and culture. Fort Worth, TX: Branch-Smith Publishing.
6. Checklist - Planting grass stolons, sprigs, and plugs.

TEACHING ACTIVITIES:

1. Outline overall procedures used to plant grass stolons, sprigs and plugs. (* 1,2,3,4 & 5)
2. Show pieces of sod with stolons and rhizomes.
3. Discuss the importance of protecting stolons, sprigs and plug from drying.
4. Present lecture on cultivation, fertilizer and/or amendment treatments required prior to planting stollens, sprigs and/or plugs. (* 1,2,3,4 & 5)
5. List turf species and/or cultivators that are commonly established using stolons, springs or plugs. (* 1,2,3,4 & 5)
6. Show an example of a site prepared for sprigging, stolonizing or plugging.
7. Assign students to check the soil moisture content.
8. Assign students to irrigate the prepared site if needed.
9. Demonstrate how to plant sprigs using the furrow/slit method.
10. Demonstrate how to plant sprigs using the insertion method.
11. Demonstrate how to plant sprigs by stolonizing.
12. Demonstrate how to plant plugs.
13. Question students on what portion of the sprig and/or plug remains above the ground.
14. Question students on the spacing of the sprigs and/or plugs.
15. Question students on the number of bushels required to stolonize a given area.
16. Monitor students as they practice planting sprigs, stollens and/or plugs.
17. Assign each student an area in which to plant sprigs, stolons, and/or plugs. (* 6)

CRITERION-REFERENCED MEASURE:

The student must check the soil moisture content at the planting site, irrigate the planting site if needed, plant the sprigs and/or plugs and irrigate

CRITERION-REFERENCED MEASURE: (cont.)

as needed until the roots are established. The sprigs and/or plugs must be planted at the assigned depth and spacing, the soil must be formed so it makes close contact with the sprigs and/or plugs and the planting site must be kept moist until roots are established.

PERFORMANCE GUIDE:

1. Inspect site to insure grading, cultivation, and fertilizer/amendment operations have been completed.
2. Irrigate site to moisten top soil.
3. Identify method of vegetative establishment recommended for particular plant species that is being used:
    A. Sprigging:
        1. Furrow/slit method:
            NOTE: Sprigs may be planted by hand or by a machine.
            a. Make 1-3 inch deep furrows or slits in prepared soil at intervals of 6-18 inches.
            b. Soak sprigs (pieces of stolons and rhizomes) in water until thoroughly moistened.
            c. Place sprigs into slits or furrows at a 4-6 inch spacing.
            d. Push soil into furrow around sprig.
                NOTE: Upper 1/4-1/3 of plant should be left above the soil line to promote top growth.
            e. Firm soil around sprig.
        2. Insertion method:
            a. Soak sprigs in water, until thoroughly moistened.
            b. Insert sprig into loose soil using a sprigging tool at intervals of approximately 6-12 inches.
                NOTE: Upper 1/4-1/3 of plant should be left above the soil line to promote top growth.

PERFORMANCE GUIDE: (cont.)

- B. Stolonizing:
  - 1. Broadcast sprigs over moist planting site at rate of 2-10 bushels per 1,000 square feet.
    CAUTION: The sprigs are very susceptible to drying.
  - 2. Cover stolons partially:
    - a. Roll or disk the stolons into the soil.
    - b. Top dress the planting area to a depth of 1/4 inch.
  - 3. Irrigate frequently during the planting process.
- C. Plugging:
  - 1. Plant plugs (small pieces of sod) to a depth of 12 inches in the prepared soil.
  - 2. Space plugs 6 to 12 inches apart.
  - 3. Roll the site:
    - a. Immediately after planting.
    - b. One to two weeks after planting.

4. Irrigate as needed until established.

CHECKLIST

DUTY Growing Plants

TASK Plant grass stolons, sprigs, and plugs.

ENABLER

1. Evaluate soil moisture content.
2. Irrigate turf.
3. Measure distance (inches/feet).
4. Calculate material needed per square feet.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plant grass stolons, sprigs, and plugs.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Inspected site to insure grading, cultivation, and fertilizer/amendment operations had been completed.		
2.	Irrigated site if needed.		
3.	Made furrows or slits in prepared soil.		
4.	Placed sprigs into slits or furrows.		
5.	Pushed soil into furrow around sprig.		
6.	Firmed soil around sprig.		
7.	Inserted sprig using a sprigging tool.		
8.	Broadcast sprigs over moist planting site at rate of 2-10 bushels per 1,000 square feet.		
9.	Rolled or disked the broadcast stolons into the soil.		
10.	Top dressed the planting area to a depth of 1/4 inch.		
11.	Planted plugs.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
12. Irrigated frequently during the planting process.		
13. Soaked sprigs until thoroughly moistened.		
14. Spaced sprigs/plugs at predetermined interval.		
15. Rolled the site.		
16. Irrigated site as needed.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 121

TASK: Prepare equipment for winter storage.

STANDARD OF PERFORMANCE OF TASK:

Winter storage preparations must prevent rust, corrosion or damage to equipment components and meet manufacturer's recommendations.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Machine Operations: Preventive Maintenance.

CONDITIONS FOR PERFORMANCE OF TASK:

Oil
Tape
Tarpaulin
Paint
Wire brush
Grease
Scrub brush
Oil can
Plastic bags
Tool kit
Cleaning fluid
Grease gun
Maintenance instructions
Putty knife/scraper
Rust/corrosion

ENABLING OBJECTIVES:

1. Read maintenance instructions.
2. Recall hand tool safety.
3. Recall lubricant/cleaning fluid safety.
4. Recall cause of rust/corrosion.

***RESOURCES:**

1. John Deere Service Publications. (1973). Fundamentals of machine operation: Preventive maintenance. Moline, IL: Author.

***RESOURCES:** (cont.)

2. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
3. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Brown, A., & Strickland, R. (1973). Tractor and small engine maintenance. Danville, IL: The Interstate Printers and Publishers, Inc.
5. Manufacturer's maintenance instructions.
6. Checklist - Preparing equipment for winter storage.

TEACHING ACTIVITIES:

1. Show examples of equipment that require preparation prior to winter storage.
2. Outline procedures used to prepare equipment for winter storage.
3. Question students on the cause of rust/corrosion.
4. Discuss the importance of maintaining equipment.
5. Show example of manufacturer's maintenance instructions. (* 5)
6. Demonstrate how to prepare machinery for winter storage. (* 1,2,3,4 & 5)
7. Demonstrate how to prepare hand tools for winter storage. (* 2,3 & 4)
8. Question students on hand tool safety.
9. Question students on lubricant/cleaning fluid safety.
10. Assign each student a list of equipment to prepare for winter storage. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the preparation required for the piece of equipment and perform the preparation. The preparation must prevent rust/corrosion and meet manufacturer's recommendations.

PERFORMANCE GUIDE:

1. Identify and assemble equipment to be prepared for winter storage.
2. Assemble tools and materials needed to perform winter preparation.

PERFORMANCE GUIDE: (cont.)

3. Perform winter preparation:
   CAUTION: Follow the manufacturer's recommendations on winter storage preparation for specified piece of equipment.
   A. Machinery:
      1. Clean exterior of machine.
      2. Operate machine until transmission oil is heated, drain then refill with fresh oil.
      3. Add corrosion and rust inhibitor to transmission oil.
         NOTE: Operate transmission until oil is thoroughly circulated.
      4. Clean and repack wheel bearings.
      5. Drain and refill hydraulic system with fresh oil.
      6. Park machine in storage shed.
      7. Drain fuel tank (gasoline and diesel only).
         CAUTION: Check with LP-gas dealer about emptying LP-gas tank.
      8. Remove, clean, and replace fuel sediment bowl and filter.
      9. Add fuel to fuel tank and run engine for several minutes.
      10. Drain fuel tank, fuel lines and carburetor.
      11. Operate engine until oil is thoroughly heated, drain and then refill with fresh oil.
      12. Seal ends of air inlet pipes, exhaust pipes, crankcase breather pipe and hydraulic system breather pipes with plastic and tape.
      13. Remove battery and clean terminals.
      14. Remove weights from tires and machine.
      15. Raise machine so tires are off the ground and inflate tires to normal pressure.
          CAUTION: Support machine securely with support stands or blocks.
      16. Release tension on all drive belts and chains.
      17. Apply grease or rust inhibitors to chains.
      18. Coat exposed metal surfaces such as axles and hydraulic piston rods with grease or a rust/corrosion inhibitor.
      19. Lubricate all points normally requiring lubrication.

PERFORMANCE GUIDE: (cont.)

20. Repair any worn or damaged part.
21. Clean off, prime and paint any rusty areas.
22. Cover machine with a tarpaulin if it is not being stored in a shed.

B. Hand tools:
  1. Remove dirt and foreign materials from tool:
    a. High power sprayer.
    b. Hand scrub.
  2. Remove rust and corrosion:
    a. Wire brush.
    b. Scraper.

C. Apply protective coating to tool:
  1. Oil.
  2. Paint.
  3. Plastic coating.

D. Place tool in specified storage area.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Prepare equipment for winter storage.

ENABLER

1. Read maintenance instructions.
2. Recall hand tool safety.
3. Recall lubricant/cleaning fluid safety.
4. Recall cause of rust/corrosion.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare equipment for winter storage.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Identified and assembled equipment to be prepared for winter storage.		
2.	Assembled tools and materials needed to perform winter preparation.		
Machinery:			
3.	Cleaned exterior of machine.		
4.	Operated machine until transmission oil is heated, drained then refilled with fresh oil.		
5.	Added corrosion and rust inhibitor to transmission oil.		
6.	Cleaned and repacked wheel bearings.		
7.	Drained and refilled hydraulic system with fresh oil.		
8.	Parked machine in storage shed.		
9.	Drained fuel tank (gasoline and diesel only).		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
10.	Removed, cleaned, and replaced fuel sediment bowl and filter.	________	________
11.	Added fuel to fuel tank and ran engine for several minutes.	________	________
12.	Drained fuel tank, fuel lines and carburetor.	________	________
13.	Operated engine until oil was thoroughly heated, drain and then refilled with fresh oil.	________	________
14.	Sealed ends of air inlet pipes, exhaust pipes, crankcase breather pipe and hydraulic system breather pipes with plastic and tape.	________	________
15.	Removed battery and cleaned terminals.	________	________
16.	Removed weight from tires and machine.	________	________
17.	Raised machine so tires are off the ground and inflated tires to normal pressure.	________	________
18.	Released tension on all drive belts and chains.	________	________
19.	Applied grease or rust inhibitors to chains.	________	________
20.	Coated exposed metal surfaces such as axles and hydraulic piston rods with grease or a rust/corrosion inhibitor.	________	________
21.	Lubricated all points normally requiring lubrication.	________	________
22.	Repaired any worn or damaged part.	________	________
23.	Cleaned off, primed and painted any rusty areas.	________	________
24.	Covered machine with a tarpaulin if it was not being stored in a shed.	________	________

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Hand tools:		
25. Removed dirt and foreign materials from tool.	________	________
26. Removed rust and corrosion.	________	________
27. Applied protective coating to tool.	________	________
28. Placed tool in specified storage area.	________	________

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 122

TASK: Construct temporary growing structures.

STANDARD OF PERFORMANCE OF TASK:

Coldframe's and hotbed's construction specifications must include a rectangular shape, the back of frame must be 6 inches taller than front, and be covered with a glazed sash. Hotbeds must have a heat source available. A temporary unheated greenhouse frame must be constructed from wood or metal and covered with polyethylene. A lathhouse must be constructed with laths running north to south with the spacing between lath equal to the width of the lath.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Sash
Tool box
Hand tools
Hot water/steam pipes
Heating cables
Framing materials
Glazing materials

ENABLING OBJECTIVES:

1. Recall hand tool/power tool safety.
2. Measure distance (inches/feet).
3. Identify north, south, east, and west.

***RESOURCES:**

1. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
2. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.

***RESOURCES:** (cont.)

4. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
5. Schmidt, J., Lewis, W., & Olin, H. (1983). Construction: Principles, materials and methods. Danville, IL: The Interstate Printers and Publishers, Inc.
6. Power tool manufacturer's operating instructions.
7. Checklist - Constructing temporary growing structures.

TEACHING ACTIVITIES:

1. Present lecture on the requirement(s) and purpose(s) of a cold frame, hotbed, unheated greenhouse and/or lathhouse.
2. List materials needed to construct temporary growing structures. (* 3 & 4)
3. List heating sources available for hotbeds.
4. Present lecture on the orientation of temporary growing structures.
5. Sketch the plans for a temporary growing structure.
6. Demonstrate how to cut a piece of lumber. (* 1,2 & 5)
7. Demonstrate how to fasten lumber together using nails/screws. (* 1 & 2)
8. Demonstrate how to cover frame with glass, fiberglass, polyethylene and/or lath. (* 1 & 2)
9. Question students on hand tool/power tool safety. (* 6)
10. Assign each student the dimensions of a temporary growing structure to construct. (* 7)

CRITERION-REFERENCED MEASURE:

The student must cut and fasten together the framing material and cover the frame according to the assigned temporary growing structure design. The temporary growing structure must be oriented as assigned, constructed of the assigned materials, the length, width and height must be the same as specified and the joints must be secure (structure remains intact during the time the it is used).

PERFORMANCE GUIDE:

1. Select type of structure to be constructed.
2. Choose location where structure will be constructed.

PERFORMANCE GUIDE: (cont.)

3. Gather construction materials:
    - A. Framing materials:
        - 1. Wood.
        - 2. Concrete.
        - 3. Prefab aluminum.
    - B. Glazing or covering materials:
        - 1. Glass.
        - 2. Fiberglass.
        - 3. Double polyethylene.
        - 4. Wood.
4. Build the specified structure:
    - A. Coldframe:
        - 1. Construct rectangular shaped frame with bottom of frame extending into the ground a few inches below the frost line.
        - 2. Construct coldframe so back of frame is approximately 12 inches and front is 6 inches tall.
        - 3. Lay glazed sash across the top.
    - B. Hotbed:
        - 1. Build a coldframe.
        - 2. Supply coldframe with a heat source:
            - a. Electric heat cables.
            - b. Hot water/steam pipes.
    - C. Unheated greenhouse:
        - 1. Construct frame to specified dimensions:
        - 2. Cover the frame with polyethylene.
          NOTE: See task "Glaze or recover greenhouse structures".
        - 3. Secure the polyethylene to frame using batten strips and nails.
    - D. Lathhouse:
        - 1. Construct a frame of specified dimensions to support the lath.
        - 2. Orient the laths so they run north to south.
        - 3. Position the lath so spacing between lath is equal to the width of the lath.
        - 4. Secure the lath to frame by nailing.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Construct temporary growing structures.

ENABLER

1. Recall hand tool/power tool safety.
2. Measure distance (inches/feet).
3. Identify north, south, east, and west.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to construct temporary growing structures.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Gathered construction materials.	______	______
2.	Built structure according to written plan.	______	______
3.	Covered the structure.	______	______
4.	Installed heat source.	______	______
5.	Secured joints on the structure.	______	______
6.	Built the structure in needed work area.	______	______

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 123

TASK: Construct planters and flats.

STANDARD OF PERFORMANCE OF TASK:

Planters and flats must be constructed using materials that will not rust, decay, or are phytotoxic to plants. The planter's or flat's depth must equal the recommended medium depth of the particular plant species that will occupy it. The design must allow water to drain from planter or flat.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Saw
Drill
Hammer
Wood
Angle irons
Screwdriver
Brass screws
Galvanized nails
Copper napthenate
Cypress, redwood, or pressure treated wood

ENABLING OBJECTIVES:

1. Look up characteristics of plants root system in reference book.
2. Recall hand tool/power tool safety.
3. Measure distance (inches/feet).

***RESOURCES:**

1. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
2. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Power tool manufacturer's operating instructions.
4. Checklist - Constructing planters and flats.

TEACHING ACTIVITIES:

1. Show examples of planters and/or flats.
2. List materials that are suitable for construction of planters and flats. (* 1 & 2)
3. List plants that are grown in planters or flats.
4. Question students on the size of a planter or flat needed for the listed plants.
5. Sketch the plans for a planter or flat.
6. Demonstrate how to cut a piece of lumber. (* 1,2 & 3)
7. Demonstrate how to faster lumber together using nails/screws. (* 1 & 2)
8. Demonstrate how to drill holes. (* 1,2 & 3)
9. Question students on hand tool/power tool and/or safety.
10. Assign each student the dimensions of a planter and/or flat to construct. (* 4)

CRITERION-REFERENCED MEASURE:

The student must cut the lumber, fasten the lumber together and provide drainage holes according to the assigned planter/flat design. The planter/flat must be constructed from the assigned materials, the length, width, depth and drainage holes must be the same as specified, and the joints must be secure (planter/flat remains intact during the time the plant is in the planter/flat).

PERFORMANCE GUIDE:

1. Calculate the dimensions of planters or flats to be constructed:
   A. Determine depth of the planter or flat.
   NOTE: Planter or flat must be deep enough to support particular plant species root system. Flats are generally 2-5 inches deep. Planters are generally 8-24 inches deep. Large plants with large roots systems may require deeper planters.
   B. Determine the width and length of planters or flats.
2. Select type of wood to use for constructing planter or flat:
   CAUTION: Wood treated with pentaclorophenol or creosote should not be used for constructing planters or flats. Both treatments are phytotoxic to plants.

PERFORMANCE GUIDE: (cont.)

- A. Cypress.
- B. Redwood.
- C. Pressure treated wood.
- D. Wood painted with copper napthenate.

3. Build planter or flat:
   - A. Make a planter:
     1. Cut 1-1 1/2 inch thick boards to specified dimensions.
     2. Construct the planter's frame:
        - a. Screw the side and end boards together using brass screws.
        - b. Screw the bottom boards to the frame with brass screws leaving a slight spacing between boards.
        - c. Reinforce edges with angle irons.
        - d. Drill a 1/2 to 1 inch drainage hole in bottom of planter.
   - B. Make a flat:
     1. Cut 1/4-1/2 inch thick boards to specified dimensions.
     2. Construct the flat's frame:
        - a. Nail the side and end boards together using galvanized nails.
        - b. Nail the bottom boards to the frame with galvanized nails leaving a 1/4-1/2 inch spacing between boards.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Construct planters and flats.

ENABLER

1. Look up characteristics of plants root system in reference book.
2. Recall hard tool/power tool safety.
3. Measure distance (inches/feet).

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to construct planters and flats.

PERFORMANCE DETERMINANTS	YES	NO
1. Gathered construction materials.	______	______
2. Built planter/flat according to written plan.	______	______
3. Secured the joints in the planter flat.	______	______

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 124

TASK: Sharpen hand tools and blades.

STANDARD OF PERFORMANCE OF TASK:

All nicks from hand tools must be removed and the hand tool/blade must be sharpened to the desired angle. Safety precautions must be observed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Oil
File
Blade
Water
Hand tool
Whet stone
Grinding wheel

ENABLING OBJECTIVES:

1. Recall hand tool safety.
2. Remove blades from mowers or other cutting equipment.

***RESOURCES:**

1. John Deere Service Publications. (1980). Fundamentals of service: Mowing and spraying equipment (5th ed.). Moline, IL: Author.
2. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
3. Coggin; Armstrong & Giles. (1987). A manual on sharpening hand woodworking tools. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
5. Equipment service instructions.
6. Checklist - Sharpening hand tools and blades.

TEACHING ACTIVITIES:

1. Discuss the importance of keeping hand tools and blades sharp.
2. Show examples of hand tools and/or blades that need to be sharpened.
3. Present lecture on reel type mowers which can be lapped without the need to disassemble the mower. (* 5)
4. Question the students on hand tool safety. (* 4)
5. Assign students to disassemble the tool or equipment and remove the blade(s). (* 5)
6. Present lecture on the importance of maintaining the appropriate angle when grinding.
7. List factors to consider when determining method to sharpen tool/blade. (*1,2 & 3)
8. Question students on the method they would use to sharpen a particular tool/blade.
9. Demonstrate how to sharpen tool/blade using a file.
10. Question students on safety precautions to take when grinding. (* 1,2,3 & 4)
11. Demonstrate how to sharpen tool/blade using grinder.
12. Discuss the importance of avoiding excess heating of the tool/blade when grinding. (* 1,2,3 & 4)
13. Demonstrate how to sharpen a tool/blade using wet stone.
14. Show examples of whet stones which were improperly used (surface not flat).
15. Demonstrate how to test tool/blades' sharpness.
16. Assign students to reassemble the tool or equipment. (* 5)
17. Monitor students as they practice sharpening tools and blades.
18. Assign each student a group of tools and/or a piece of equipment for which to sharpen the blade(s). (* 6)

CRITERION-REFERENCED MEASURE:

The student must remove the blade if required, determine the method for sharpening, sharpen the tool/blade and reassemble the tool or equipment if required. The selected method of sharpening must be appropriate, all nicks must be removed, the desired angle must be maintained and all safety precautions must be observed.

PERFORMANCE GUIDE:

1. Identify type of hand tool/blade to be sharpened.
2. Disassemble tool, if necessary.
3. Identify method to sharpen tool/blade:
   A. Sharpen tool/blade with file or grinder wheel:
      1. Select proper equipment.
      2. Identify original angle of bevel to use as a guide.
      3. Use proper eye and hand protection.
      4. Hold tool/blade at appropriate angle.
      5. Sharpen tool/blade by starting at the point working towards blunt end.
      6. Inspect edge after each stroke.
      7. Repeat until all nicks are removed from cutting edge.
   B. Sharpen tool/blade with whet stone:
      1. Select whet stone.
      2. Lubricate the stone with water or oil during sharpening process.
      3. Place only the beveled edge of tool/blade on the whet stone at the appropriate angle.
         NOTE: Use original angle of bevel as a guide.
      4. Move the blade across the stone using a sweeping action until blade is sharpened to desired sharpness.
         NOTE: Use the entire width of the whet stone surface, in order to keep the whet stone surface flat.
      5. Lay the inside face of the blade on the whet stone.
      6. Remove wire edge using light pressure and circular motion.
4. Test tool/blade's sharpness.
5. Repeat sharpening process if necessary.
6. Assemble tool.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Sharpen hand tools and blades.

ENABLER

1. Recall hand tool safety.
2. Remove blades from mowers or other cutting equipment.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**_________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to sharpen hand tools and blades.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Disassembled tool, if necessary.		
2.	Selected proper sharpening tools or equipment.		
3.	Maintained original angle of bevel.		
4.	Used eye and hand protection.		
Whet stone:			
5.	Lubricated the stone.		
6.	Maintained original angle of bevel.		
7.	Used the entire width of the whet stone surface.		
8.	Removed wire edge.		
9.	Tested tool/blade's sharpness.		
10.	Assembled tool.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 125

TASK: Perform preventive maintenance of equipment.

STANDARD OF PERFORMANCE TASK:

Preventive maintenance must be performed in compliance with the American Society of Agriculture Engineers (ASAE) recommended service intervals on machines, or according to manufacturer's recommendations.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Machine Operation: Preventive Maintenance.

CONDITIONS FOR PERFORMANCE OF TASK:

Lubricant
Tool kit
Pen/pencil
Maintenance instructions
Replacement parts
Equipment to be serviced
Preventive maintenance schedule

ENABLING OBJECTIVES:

1. Read preventive maintenance schedule.
2. Use calculator to add, subtract, multiply and/or divide.
3. Write or print information on preventive maintenance schedule.

***RESOURCES:**

1. John Deere Service Publications. (1973). Fundamentals of machine operation: Preventive maintenance. Moline, IL: Author.
2. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
3. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

4. Roth, A., & Baird, R. (1985). Small gas engines. Fort Atkinson, WI: Nasco.
5. Brown, A., & Strickland, R. (1973). Tractor and small engine maintenance. Danville, IL: The Interstate Printers and Publishers, Inc.
6. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.
7. Preventive maintenance schedule.
8. Manufacturer's maintenance instructions.
9. Checklist - Performing preventive maintenance of equipment.

TEACHING ACTIVITIES:

1. Question students on the importance of preventive maintenance.
2. List equipment that requires preventive maintenance. (* 1,2,3,4,5 & 6)
3. List preventive maintenance required for listed equipment. (* 1,2,3,4,5 & 6)
4. Show an example of a preventive maintenance schedule. (* 7)
5. Question students on the purpose of the preventive maintenance schedule.
6. Show examples of equipment with hour meters.
7. Present lecture on the conversion of hourly service to days of operation.
8. Show an example of manufacturer's maintenance instructions. (* 8)
9. Present lecture on how to determine the maintenance due to be performed on a piece of equipment.
10. Demonstrate how to perform the scheduled maintenance.
11. Demonstrate how to record the completed maintenance. (* 7)
12. Assign each student a piece of equipment on which to perform preventive maintenance. (* 9)

CRITERION-REFERENCED MEASURE:

The student must determine the maintenance due to be performed, complete the scheduled maintenance and record the completed maintenance. All maintenance due to be performed must be identified, completed and recorded.

PERFORMANCE GUIDE:

1. Identify hours of operations on equipment:
   - A. Equipment hour meter.
   - B. Preventive maintenance schedule.
2. Convert recommended hourly service intervals to days of operation:
   - A. 5 hours (twice daily).
   - B. 10 hours (daily).
   - C. 50 hours (weekly).
   - D. 250 hours (monthly).
   - E. 500 hours (bi-monthly).
   - F. 1,000 hours (season).
3. Check preventive maintenance schedule or maintenance instructions to determine maintenance due to be performed.
4. Complete scheduled maintenance.
5. Record completed maintenance on preventive maintenance schedule:
   - A. Date.
   - B. Operation hours on equipment.
   - C. Maintenance performed.
   - D. Performer's signature.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Perform preventive maintenance of equipment.

ENABLER

1. Read preventive maintenance schedule.
2. Use calculator to add, subtract, multiply and/or divide.
3. Write or print information on preventive maintenance schedule.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to perform preventive maintenance of equipment.

PERFORMANCE DETERMINANTS	YES	NO
1. Recorded hours of operations on equipment.	________	________
2. Listed the convert recommended hourly service intervals as days of operation.	________	________
3. Listed maintenance that was due to be performed.	________	________
4. Completed the maintenance.	________	________
5. Recorded completed maintenance.	________	________

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 126

TASK: Service engine oil and filter.

STANDARD OF PERFORMANCE OF TASK:

The oil in the engine crankcase and filter should be changed as recommended in the maintenance instructions. Engine oil must be identified and replaced with the viscosity and service classification specified in the engine's maintenance instructions. No leaks must be observable after servicing.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Machine Operation:
Preventive Maintenance.
Fundamentals of Service: Engines.

CONDITIONS FOR PERFORMANCE OF TASK:

Oil
Oil pan
Tool kit
Oil filter
Clean, lint-free rags
Filter remover
Oil viscosity/classification chart

ENABLING OBJECTIVES:

1. Recall hand tool safety.
2. Read maintenance instructions.

***RESOURCES:**

1. John Deere Service Publications. (1980). Fundamentals of service: Engines (5th ed.). Moline, IL: Author.
2. Roth, A., & Baird, R. (1985). Small gas engines. Fort Atkinson, WI: Nasco.
3. Brown, A., & Strickland, R. (1973). Tractor and small engine maintenance. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

4. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
5. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
6. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.
7. Manufacturer's maintenance instructions.
8. Checklist - Servicing engine oil and filter.

TEACHING ACTIVITIES:

1. Question students on the importance of servicing engine oil and filter. (* 1,2,3,4 & 5)
2. List equipment that requires engine oil. (* 1,2 & 3)
3. List engine oil service intervals for the listed equipment. (* 1,2 & 3)
4. Outline procedures used to service engine oil and filter. (* 1,2,3,4 & 5)
5. Question students on the importance of running the engine until warm before servicing the engine oil and filter.
6. Demonstrate how to block tires and remove the crankcase drain plug.
7. Assign students to wipe dirt from filter and surrounding area.
8. Demonstrate how to loosen and remove the oil filter.
9. Present lecture on disposal of old oil and old filter.
10. Demonstrate how to replace the crack case drain plug.
11. Present lecture on identification of oil filter code from maintenance instructions. (* 7)
12. Demonstrate how to install the filter gasket and filter.
13. Question students on the importance of using the correct oil viscosity and classification.
14. Assign students to add new engine oil.
15. Assign students to start the engine.
16. Assign students to check for oil leaks.
17. Demonstrate how to check the oil level on the dipstick.
18. Assign each student a piece of equipment for which to service engine oil and filter. (* 8)

CRITERION-REFERENCED MEASURE:

The student must list the engine oil and filter required, run the engine until it is warm, drain the crankcase, remove and replace the filter, fill the crankcase with new oil, and identify any oil leaks. The listed/engine oil and oil filter must be the same as recommended by the manufacturer, all oil must be allowed to drain after the engine has been warmed, the filter with gasket must be replaced according to recommended procedures, dipstick must indicate that crankcase is full and all leaks must be identified.

PERFORMANCE GUIDE:

1. Run engine until warm.
2. Shut off engine, block tires and remove drain plug.
   CAUTION: Magnetic plugs may have metal particles in them. Strike the plug against a solid object to dislodge them. Care must be taken not to damage plug threads.
3. Allow the oil to drain completely from all engine parts.
4. Wipe dirt from filter and surrounding area.
5. Loosen and remove the oil filter and discard it.
6. Replace and tighten crankcase drain plug.
7. Identify oil filter code number from maintenance instructions.
8. Install a new filter gasket and apply a light coat of crankcase oil to it prior to installing.
9. Install new oil filter.
   NOTE: With spin-on filters, turn the filter until the seal contacts the base, then tighten no more than 1/2 extra turn.
10. Start the engine and operate for a few minutes.
11. Check for leaks around drain plug and oil filter.
12. Check oil level on dipstick and verify oil is on full line.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Service engine oil and filter.

ENABLER

1. Recall hand tool safety.
2. Read maintenance instructions.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to service engine oil and filter.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Ran engine until warm.		
2.	Blocked tires and remove drain plug.		
3.	Cleaned drain plug.		
4.	Drained oil completely from engine.		
5.	Wiped dirt from filter and surrounding area.		
6.	Removed the oil filter.		
7.	Replaced the crankcase drain plug.		
8.	Listed the oil filter code number.		
9.	Installed filter gasket.		
10.	Installed oil filter.		
11.	Started the engine.		
12.	Checked for leaks.		
13.	Checked dipstick (full oil).		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 127

TASK: Perform minor engine tune-up.

STANDARD OF PERFORMANCE OF TASK:

Engine tune-up must occur at manufacturer's suggested period of operation, either spring and fall or every 500-1000 hours of operation. Engine tune-up must include the air intake and exhaust system, ignition system, fuel systems, lubricating system, cooling system and electrical system.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Machine Operation: Preventive Maintenance.

CONDITIONS FOR PERFORMANCE OF TASK:

Tune-up tools
Engine to be tuned
Engine tune-up instructions
Engine parts (varies with job)

ENABLING OBJECTIVES:

1. Recall hand tool safety.
2. Read engine tune-up instructions.
3. Write or print information on maintenance records.

***RESOURCES:**

1. John Deere Service Publications. (1980). Fundamentals of service: Engines (5th ed.). Moline, IL: Author.
2. Roth, A., & Baird, R. (1985). Small gas engines. Fort Atkinson, WI: Nasco.
3. Brown, A., & Strickland, R. (1973). Tractor and small engine maintenance. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
5. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

6. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.
7. Engine tune-up instructions.
8. Maintenance records.
9. Checklist - Performing minor engine tune-up.

TEACHING ACTIVITIES:

1. Question students on the importance of performing a minor engine tune-up.
2. List equipment that requires minor engine tune-ups
3. List the time of year and/or how often that minor engine tune-ups should be performed on the listed equipment. (* 1,2,3,4,5,6 & 7)
4. List parts of the engine system that require inspection and/or service. (* 1,2,3,4,5,6 & 7)
5. Present lecture on how to identify the engine identification number, model number, type and make of motor.
6. Present lecture on how to determine which manuals the resource materials available to help when performing work on specific engine systems. (* 7)
7. Present lecture on how to determine which tools and/or parts are required to perform work on specific engine systems. (* 1,2,3,4,5,6 & 7)
8. Demonstrate how to inspect and service air intake and exhaust system.
9. Demonstrate how to inspect and service ignition system.
10. Demonstrate how to inspect and service fuel system.
11. Demonstrate how to inspect and service lubricating system.
12. Demonstrate how to inspect and service cooling system.
13. Demonstrate how to inspect and service electrical system.
14. Discuss the importance of following manufacturer's procedures and specifications.
15. List information recorded in the maintenance records. (* 8)
16. Discuss the importance of recording the work performed neatly and accurately.
17. Assign each student a piece of equipment for which to perform a minor engine tune-up. (* 9)

CRITERION-REFERENCED MEASURE:

The student must list the engine identification number, model number, type and make of motor, assemble the required tools, parts and manuals, inspect the engine system, perform work required and record work performed. The listed information must be legible and accurate, all required items must be assembled, all required work must be performed according to manufacturers' specifications and the maintenance records must be legible and complete.

PERFORMANCE GUIDE:

1. Identify engines ID number, model number, type and make of motor.
2. Assemble tools, parts and manuals.
3. Inspect engine system:
    A. Air intake and exhaust system:
        1. Clean out precleaner.
        2. Remove and clean air cleaner/filter.
        3. Inspect exhaust system and muffler.
        4. Check crankcase ventilating system for restrictions.
        5. Check manifold for leaks.
        6. Check radiator for air bubbles or oil.
           NOTE: Air bubbles indicate a compression leak and oil indicates oil leakage.
        7. Check cylinder head gasket for leaks.
        8. Retighten cylinder head cap screws.
        9. Adjust valve tappet clearance.
        10. Check engine compression.
    B. Ignition system (spark-ignition engines):
        1. Check spark plugs:
            a. Clean and adjust gap.
            b. Check spark plug wires.
        2. Check distributor:
            a. Cap and rotor.
            b. Breaker points.
            c. Breaker point gap.
            d. Cam lubrication.
            e. Distributor timing.
    C. Fuel system:
        1. Check fuel lines for leaks or restrictions.
        2. Clean fuel pump sediment bowl.
        3. Clean fuel filter or strainer.
        4. Check radiator for LP-gas leaking from convertor into cooling system.
        5. Drain sediment from fuel tank.
        6. Bleed diesel fuel system.

PERFORMANCE GUIDE: (cont.)

- D. Lubricating system:
  - 1. Check operation of pressure light or gauge.
  - 2. Drain and refill crankcase.
  - 3. Replace oil filter.
- E. Cooling system:
  - 1. Check water pump for leaks and excessive shaft endplay.
  - 2. Inspect radiator hoses.
  - 3. Clean and flush cooling system.
  - 4. Test thermostat operation.
  - 5. Check radiator for leaks.
  - 6. Check condition of fan belt.
- F. Electrical system:
  - 1. Check battery:
    - a. Clean battery, cables and terminals.
    - b. Tighten battery cables and battery hold down clamps.
    - c. Coat cleaned battery cables and posts with petroleum jelly or grease.
    - d. Check specific gravity of electrolyte and add water to the proper level.
  - 2. Check generator and alternator:
    - a. Check belt tension.
    - b. Check voltage output.

4. Correct malfunctions or improper setting according to manufacturer's specifications.
5. Record tune-up date, findings and preventive measures taken in maintenance records.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Perform minor engine tune-up.

ENABLER

1. Recall hand tool safety.
2. Read engine tune-up manual.
3. Write or print information on maintenance records.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to perform minor engine tune-up.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Listed engine ID number, model number, type and make of motor.	______	______
2.	Assembled tools, parts and manuals.	______	______
Air intake and exhaust system:			
3.	Cleaned precleaner.	______	______
4.	Removed and cleaned air cleaner/filter.	______	______
5.	Inspected exhaust system and muffler.	______	______
6.	Checked crankcase ventilating system for restrictions.	______	______
7.	Checked manifold for leaks.	______	______
8.	Checked radiator for air bubbles or oil.	______	______
9.	Checked cylinder head gasket for leaks.	______	______
10.	Retightened cylinder head cap screws.	______	______
11.	Adjusted valve tappet clearance.	______	______
12.	Checked engine compression.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Ignition system:		
13. Cleaned and adjusted gap.		
14. Checked spark plug wires.		
15. Checked cap and rotor.		
16. Checked breaker points.		
17. Checked breaker point gap.		
18. Checked cam lubrication.		
19. Checked distributor timing.		
20. Checked fuel lines for leaks.		
21. Cleaned fuel pump sediment bowl.		
22. Cleaned fuel filter or restrainer.		
23. Checked radiator for LP-gas leaking from convertor into cooling system.		
24. Drained sediment from fuel tank.		
25. Bled diesel fuel system.		
Lubricating system:		
26. Checked operation of pressure light or gauge.		
27. Drained and refilled crankcase.		
28. Replaced oil filter.		
Cooling system:		
29. Checked water pump.		
30. Inspected radiator hoses.		
31. Cleaned and flush cooling system.		
32. Tested thermostat.		
33. Checked radiator for leaks.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
34. Checked condition of fan belt.	________	________
Electrical system:		
35. Cleaned battery, cables and terminals.	________	________
36. Tightened battery cables and battery hold down clamps.	________	________
37. Coated cleaned battery cables and posts.	________	________
38. Checked specific gravity of electrolyte and added water to the proper level.	________	________
39. Checked belt tension.	________	________
40. Checked voltage output.	________	________
41. Corrected malfunctions or improper setting.	________	________
42. Recorded work performed.	________	________

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 128

TASK: Maintain irrigation systems.

STANDARD OF PERFORMANCE OF TASK:

Irrigation system must be free from leakage and system must be functional

SOURCE OF STANDARD:

Writing team of incumbent workers.
Planning for an Irrigation System.

CONDITIONS FOR PERFORMANCE OF TASK:

Tool kit
Fine wire
Replacement parts
System maintenance manual

ENABLING OBJECTIVES:

1. Read irrigation system manual.
2. Write or print information in maintenance records.
3. Recall changes in temperature during seasons of the year.

***RESOURCES:**

1. Israelsen, O., & Hansen, V. (1980). Irrigation principles and practices. Fort Atkinson, WI: Nasco.
2. Irrigation Technical Services. (1982). The abc's of lawn sprinkler systems.
3. Preventive maintenance chart.
4. Checklist - Maintaining irrigation systems.

TEACHING ACTIVITIES:

1. List types of irrigation systems. (* 1 & 2)
2. List components of an irrigation system. (* 1 & 2)
3. Present lecture on the time of year during which irrigation systems are maintained. (* 1 & 2)
4. List maintenance performed prior to freezing weather. (* 1 & 2)

TEACHING ACTIVITIES: (cont.)

5. List problems with irrigation systems that require maintenance.
6. Present lecture on analysis of water quality.
7. Present lecture on evaluation of water sources.
8. Demonstrate how to lubricate a water pump.
9. Demonstrate how to back wash a filter.
10. Demonstrate how to test control valves.
11. Demonstrate how to check for clogged nozzles and sprinklers.
12. Demonstrate how to inspect for leaks in water pumps, filters, valves, water lines, booms, nozzles and sprinklers.
13. Demonstrate how to drain irrigation lines.
14. Discuss the importance of recording work performed on preventive maintenance chart.
15. Demonstrate how to record the work performed on a preventive maintenance chart. (* 3)
16. Assign each student an irrigation system to maintain. (* 4)

CRITERION-REFERENCED MEASURE:

The student must inspect all parts of the irrigation system, list any malfunctioning components, parts in need of cleaning or lubrication, perform needed maintenance, and record work performed. The irrigation system must be functional and free from leakage or prepared for freezing weather (irrigation lines do not burst) and information recorded on preventive maintenance chart must be complete and legible.

PERFORMANCE GUIDE:

1. Identify type of irrigation system:
    A. Sprinkler.
    B. Surface.
    C. Trickle.
    D. Subirrigation.
2. Inspect irrigation systems:
    A. Water source:
        1. Well.
        2. Lake.
        3. Stream.
        4. Reservoir.
        5. Cistern.

PERFORMANCE GUIDE: (cont.)

   B. Water pump.
   C. Filters.
   D. Control valves.
   E. Main water lines.
   F. Lateral lines/booms.
   G. Nozzles/sprinklers.

3. Correct malfunctioning component:
   A. Replace part.
   B. Unclog part.
   C. Clean part.
4. Drain irrigation lines during freezing weather to protect them from freezing or bursting.
5. Record maintenance on preventive maintenance chart.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Maintain irrigation systems.

ENABLER

1. Read irrigation system manual.
2. Write or print information in maintenance records.
3. Recall changes in temperature during seasons of the year.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain irrigation systems.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Recorded evaluation of water source.		
2.	Completed maintenance on water pump.		
3.	Completed maintenance on filters.		
4.	Tested control valves.		
5.	Tested main water lines.		
6.	Tested lateral lines/booms.		
7.	Cleaned or replaced nozzles/sprinklers.		
8.	Drained irrigation lines prior to freezing weather.		
9.	Recorded maintenance on preventive maintenance chart.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 129

TASK: Glaze or recover greenhouse structures.

STANDARD OF PERFORMANCE OF TASK:

All manufacturer's and company's safety recommendations must be observed. Glass must be cut to specified dimensions and installed with glazing compound on a clean bar or frame. Polyethylene must be pulled taught over a smooth frame, and secured with nails and batten strips. Fiberglass and rigid double plastic must be installed according to manufacturer's recommendations. Glazing or recovering material must not leak water.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Glass
Nails
Greenhouse
Fiberglass
Glass cutter
Putty knife
Polyethylene
Batten strips
Glazing compound
Rigid plastic
Recommended molding strips, screws, rivets, or fasteners

ENABLING OBJECTIVES:

1. Recall hand tool safety.
2. Evaluate weather conditions (wind/heat).

***RESOURCES:**

1. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
2. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.

***RESOURCES:** (cont.)

3. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
5. Checklist - Glazing or recovering a greenhouse structure.

TEACHING ACTIVITIES:

1. Question students on the crop damage possible due to inadequate glazing or recovering of a greenhouse structure.
2. Show examples of materials used to cover greenhouse structures.
3. Discuss the advantages and disadvantages of the covering materials. (* 1,2,3, & 4)
4. Question students of safety precautions to take when handling the covering materials.
5. Demonstrate how to install the glazing materials.
6. Question students on hand tool and material safety.
7. Question students on the weather conditions suitable for glazing or recovering a greenhouse structure.
8. Assign each student a greenhouse structure to glaze or recover. (* 5)

CRITERION-REFERENCED MEASURE:

The student must determine if the weather conditions are suitable and install the glazing materials. All manufacturer's and company's safety recommendations must be observed. Glass must be cut to specified dimensions and installed with glazing compound on a clean bar or frame. Polyethylene must be pulled taught over a smooth frame, and secured with nails and batten strips. Fiberglass and rigid double plastic must be installed according to manufacturer's recommendations. Glazing or recovering material must not leak water.

PERFORMANCE GUIDE:

1. Select type of glazing or recovering material required to glaze specified greenhouse structure:
   - A. Glass.
   - B. Polyethylene.
   - C. Fiberglass.
   - D. Rigid double plastics.

PERFORMANCE GUIDE: (cont.)

2. Gather required materials and tools.
3. Install glazing material on greenhouse structure:
   CAUTION: Follow all manufacturer's and company's safety procedures for installing glazing or recovering material.
   - A. Install glass:
     1. Cut the glass to specified dimensions:
        - a. Scratch glass with a glass cutter at specified dimensions.
        - b. Make a clean break using a pair of pliers or breaking over the edge of a table at the scratched line.
     2. Remove old putty from bar or frame:
        - a. Heat the putty with a propane torch.
        - b. Scrape off putty using a putty knife.
     3. Place glass against bar or frame:
        NOTE: Wooden frames may need to be painted with white primer paint before glass is installed.
     4. Seal the glass:
        - a. Apply a thin layer of glazing compound to the bar or frame to form a water tight union.
   - B. Recover with polyethylene:
     1. Select calm, warm, dry day to recover greenhouse with polyethylene film.
     2. Remove any rough points on the frame.
        CAUTION: Polyethylene can be easily ripped if it catches on any rough or jagged points.
     3. Position polyethylene on the frame so it is taught.
     4. Secure polyethylene by nailing batten strips along all cut edges.
        CAUTION: Polyethylene must be taught when it is secured.
        CAUTION: Do not drive nails within 2 inches of the edge of the polyethylene film.
   - C. Install fiberglass or rigid plastic:
     CAUTION: Follow manufacturer's recommendations for installing fiberglass or rigid plastic.
     1. Lay fiberglass or rigid plastic on framework.
     2. Overlap panels by the specified distance.
     3. Secure panels using manufacturer's special molding strips, screws, rivets, or fasteners.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Glaze or recover greenhouse structures.

ENABLER

1. Recall hand tool safety.
2. Evaluate weather conditions (wind/heat).

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to glaze or recover greenhouse structures.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified the type of glazing or recovering material required.		
2. Gathered required materials and tools.		
3. Made the repair:		
- Scratched glass with a glass cutter.		
- Made a clean break.		
- Removed old putty from bar or frame.		
- Placed glass against bar or frame.		
- Sealed the glass.		
4. Polyethylene:		
- Selected calm, warm, dry day to recover greenhouse.		
- Removed any rough points on the frame.		
- Positioned polyethylene on the frame.		
- Secured polyethylene.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
5. Fiberglass or rigid plastic:		
- Laid fiberglass or rigid plastic on framework.	________	________
- Overlapped panels.	________	________
- Secured panels.	________	________

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 130

TASK: Clean work area.

STANDARD OF PERFORMANCE TASK:

All tools and containers must be put in storage area and all trash disposed. The work area must be clean. Potting benches must be disinfested.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Disinfestant
Dirty work area
Cleaning supplies

ENABLING OBJECTIVES:

1. Recall storage area for tools and supplies.
2. Mix disinfestant solution.
3. Dispose of horticultural waste (plant materials, chemicals).

***RESOURCES:**

1. Disinfestant label.
2. Horticultural chemical label.
3. Checklist - Cleaning the work area.

TEACHING ACTIVITIES:

1. Question students on the problems associated with not cleaning the work area.
2. List specific standards for cleaning the work area.
3. Discuss the importance of storing tools where they can be found.
4. Discuss the importance of removing grease and oil from the floor.
5. Discuss the importance of disinfesting work areas.
6. Question students on how to mix a disinfesting solution. (* 1)
7. Question students on disposal of horticultural chemicals. (* 2)

TEACHING ACTIVITIES: (cont.)

8. Assign each student a period of time during which to clean the work area. (* 3)

CRITERION-REFERENCED MEASURE:

The student must store tools and supplies, clean floors, disinfest benches and dispose of trash. All tools and supplies must be stored in assigned area, floors must be free of grease, oil, and trash, all plant material must be handled in such a way that contamination of the growing area, and/or potting area is avoided, all horticultural chemicals must be disposed of according to manufacturer's recommendations and potting benches must be disinfested.

PERFORMANCE GUIDE:

1. Select cleaning utensils and supplies.
2. Return all hand tools to storage area.
3. Move dirty pots, flats, and containers from work area to pot sanitizing area.
4. Pick up loose paper, boxes and packing material and deposit in trash containers.
5. Sweep work benches and floor.
6. Remove any oil or grease which has accumulated on floor or benches.
7. Dispose of all trash and debris deposited in the trash containers.
8. Clean and disinfest potting benches.
9. Mop or hose down the floor.
10. Return cleaning utensils and supplies to their storage area.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Clean work area.

ENABLER

1. Recall storage area for tools and supplies.
2. Mix disinfestant solution.
3. Dispose of horticultural waste (plant materials, chemicals).

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to clean work area.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Selected cleaning utensils and supplies.		
2.	Returned all hand tools to storage area.		
3.	Moved dirty pots, flats, and containers from work area to pot sanitizing area.		
4.	Picked up loose paper, boxes and packing material and deposit in trash containers.		
5.	Swept work benches and floor.		
6.	Removed any oil or grease which has accumulated on floor or benches.		
7.	Disposed of all trash and debris deposited in the trash containers.		
8.	Cleaned and disinfested potting benches.		
9.	Mopped or hosed down the floor.		
10.	Returned cleaning utensils and supplies to their storage area.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 131

TASK: Dispose of waste material.

STANDARD OF PERFORMANCE OF TASK:

All waste materials must be removed from work area, transported to appropriate disposal area and disposed of according to city, state, and federal disposal guidelines.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Pitchfork
Compost pile
Garbage cans
Waste dumpsters
Plastic garbage bags
Wheelbarrow/disposal cart

ENABLING OBJECTIVES:

1. Identify unwanted items and materials.
2. Handle horticultural chemicals.
3. Lift, carry and dump items and materials.

***RESOURCES:**

1. Shewell, & Cooper. Compost gardening. New York, NY: Macmillan.
2. Bennett, C. (1983). Conservation and management of natural resources in the United States. Somerset, NJ: John Wiley & Sons, Inc.
3. Haskell, P. (1985). Pesticide application: Principles and practices. New York, NY: Oxford University Press.
4. Checklist - Disposing of waste material.

TEACHING ACTIVITIES:

1. Show examples of several kinds of waste materials.
2. List problems associated with disposal of different types of waste materials. (* 2)

TEACHING ACTIVITIES: (cont.)

3. Present lecture on city, state and federal disposal guidelines for different types of waste materials.
4. Present lecture on composting methods. (* 1)
5. Present lecture on burning site requirements.
6. Present lecture on handling of sharp and abrasive waste materials.
7. Present lecture on handling of horticultural chemicals and containers. (* 3)
8. Question students on how to lift, carry and dump waste materials.
9. Question students on safety considerations required when handling different types of waste materials.
10. Assign each student waste materials to be disposed. (* 4)

CRITERION-REFERENCED MEASURE:

The student must determine the type of waste material, record safety considerations for handling the waste material, select method of waste disposal, and collect, transport and dump the waste materials. All waste materials must be disposed of according to the selected waste disposal method.

PERFORMANCE GUIDE:

1. Identify type of waste to be disposed of:
    - A. Organic:
        1. Herbaceous.
        2. Woody.
    - B. In-organic:
        1. Glass.
        2. Metal.
        3. Plastic/fiberglass.
        4. Rock/stone.
    - C. Toxic:
        1. Fertilizer/pesticide containers.
        2. Fertilizer/pesticide residue.
           NOTE: Never dispose of residue directly on the ground.
2. Transport waste to appropriate disposal area:
    - A. Compost area:
        1. Organic:
            - a. Herbaceous.
            - b. Wood chips.
    - B. Burning site:
        1. Organic.
            - a. Wood.
            - b. Paper.

PERFORMANCE GUIDE: (cont.)

- C. Landfill/disposal site:
  - 1. Inorganic:
    - a. Metal.
    - b. Glass.
    - c. Plastic/fiberglass.
    - d. Rock/stone.
- D. Hazardous material disposal site/chemical dealer:
  - 1. Toxic material:
    - a. Pesticide/fertilization containers.

3. Dump waste material as directed by site manager/operator.
4. Record hazardous material disposed of:
   - A. Name of disposal site.
   - B. Time and date of disposal.
   - C. Type of materials disposed of.
   - D. Material carrier.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Dispose of waste material.

ENABLER

1. Handle horticultural chemicals.
2. Lift, carry and dump items and materials.

STUDENT'S NAME____________________ **DATE**__________

EVALUATOR'S NAME____________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use this checklist to evaluate a student's ability to dispose of waste materials.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified type of waste.	______	______
2. Listed safety considerations for type of waste.	______	______
3. Recorded method of waste disposal used.	______	______
4. Selected method of waste disposal met city, state, and federal disposal guidelines.	______	______
5. Disposed of waste material according to selected method.	______	______

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 132

TASK: Replace drive chain.

STANDARD OF PERFORMANCE OF TASK:

Drive chain must transmit power from one rotating shaft to another without slippage. The links of the drive chain must mesh with the teeth of the sprockets and maintain a positive speed ratio between the driving and driven components. Drive chain and sprockets must be aligned, chain tension adjusted and the chain must be lubricated. Slippage, vibration and excessive noise must not be observed.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Machine Operation: Preventive Maintenance.
Fundamentals of Service: Belts and Chains.

CONDITIONS FOR PERFORMANCE OF TASK:

Brush
Hammer
Solvent
Oil can
Wrenches
Straight edge
Lubricating oil
Replacement chain
Chain detaching tool
Chain wear limit chart
Maintenance instructions
Equipment maintenance manual

ENABLING OBJECTIVES:

1. Recall hand tool safety.
2. Read maintenance instructions.

***RESOURCES:**

1. John Deere Service Publications. (1980). Fundamentals of service: Belts and chains (3rd ed.). Moline, IL: Author.

*RESOURCES: (cont.)

2. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
3. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.
5. Maintenance instructions.
6. Checklist - Servicing drive chains.

TEACHING ACTIVITIES:

1. List pieces of equipment that have drive chains. (* 1)
2. Question students on problems associated with inadequate adjustments or lubrication of chains or worn/damaged chains.
3. Show examples of types of chain drive systems.
4. Show examples of sprockets.
5. Show examples of chains with broken pins, bushings or rollers and or stiff chains.
6. Show examples of maintenance instructions. (* 5)
7. Demonstrate how to remove tension from chains. (* 1,2,3,4 & 5)
8. Demonstrate to remove the master link. (* 1,2,3,4, & 5)
9. Demonstrate how to remove the chain from the drive sprockets. (* 1,2,3,4, * 5)
10. Discuss the importance of not removing chains while the equipment is running.
11. Present lecture on the cleaning and inspection of chains. (* 1,2,3,4, & 5)
12. Questions students on the condition of the removed chain and the sprockets.
13. Demonstrate how to align shafts and sprockets. (* 1,2,3,4, & 5)
14. Demonstrate how to install the drive chain on sprockets. (* 1,2,3,4, & 5)
15. Demonstrate how to adjust the drive chain tension.
16. Discuss the importance of replacing shields and guards.
17. Demonstrate how to lubricate the chain.
18. Monitor students as they practice servicing drive belts.
19. Assign each student a piece of equipment for which to service the drive chain(s). (* 6)

CRITERION-REFERENCED MEASURE:

The student must remove the drive chain, inspect the chain and sprockets, clean and inspect the chain, install a new chain if needed, or reinstall the chain and adjust the chain tension and lubricate the chain. The student must explain the reasons for installing a new chain or reinstalling the chain. Chain tension must meet manufacturer's specifications (drive chains must not slip or vibrate) and all guards and shields must be replaced.

PERFORMANCE GUIDE:

1. Identify type of drive chain and location:
   - A. Roller chain.
   - B. Rollerless chain.
   - C. Silent chain.
   - D. Detachable link chain.
   - E. Pintle chain.
   - F. Block chain.
2. Remove chain from drive sprocket:
   - A. Decrease chain tension until "slack" is created.
   - B. Locate master link and remove cotter pin or retaining clip.
   - C. Remove side bar.
   - D. Place detaching tool on master link and remove link.
     NOTE: Always support chain while detaching it.
   - E. Lift drive chain from drive sprockets.
     CAUTION: Do not attempt to work on drive chains while engine or motor is running.
3. Inspect chain and sprockets:
   - A. Place chain in container of cleaning solvent and clean chain.
   - B. Check chain for broken pins, bushings, or rollers.
   - C. Check chain for stiffness.
   - D. Check sprocket for worn or broken teeth.
4. Align shafts and sprockets:
   - A. Level the shafts by placing a machinists level directly on the shafts.
   - B. Align the shafts using a feeler bar until they are parallel.
   - C. Recheck the level adjustment and tighten all securing bolts and nuts.

PERFORMANCE GUIDE: (cont.)

- D. Align the sprockets axially on the shaft using a straight edge.
  NOTE: Apply straight edge to a finished surface on the sprocket.
- E. Tighten sprocket setscrews or collars.

5. Install drive chain on sprockets:
   - A. Loosen the chain tighteners to provide slack.
   - B. Place chain in place and bring the ends of the chain together over one sprocket so teeth holds the chain in place.
   - C. Insert pin or pin link to couple chain together.
   - D. Place side plate on pins or put cotter key/retaining clip in place.
   - E. Adjust drive chain tension:
     1. Identify type and location of chain tightener:
        - a. Screw.
        - b. Gravity.
        - c. Spring.
        - d. Catenary.
     2. Remove chain "slack":
        - a. Horizontal and inclined drives should be about 1/4 inch per foot between shaft center (with one side of chain taut).
        - b. Vertical drives and those subject to shock loading or reversal of rotation should be adjusted so that both spans of chain are almost taut.
        - c. For drives on fixed centers, chain tension is usually controlled by an adjustable chain tightener such as an idler sprocket or a shoe.
        - d. Estimate amount of chain sag by pulling one side of chain taut, allowing the excess chain to accumulate in the opposite span.
        - e. Place a straight edge on the slack span and pull the chain down at the center.
        - f. Measure sag from the top of chain to the underside of the straight edge.
        - g. Adjust tightener or shaft center to provide recommended amount of sag for proper chain slack.
          CAUTION: Never attempt to adjust chains while the machine is running. Always shut off the machine prior to servicing.

PERFORMANCE GUIDE: (cont.)

6. Install all chain guards and shields in place prior to operation.
7. Lubricate the chain:
    A. Determine the method of lubrication:
        1. Manual:
            a. Brush or oil can.
            b. Pressure lubricating.
        2. Semi-automatic:
            a. Drip cup.
        3. Automatic:
            a. Oil bath.
            b. Oil dish.
            c. Oil stream.
    B. Apply lubricant.
8. Run chain drive for a short period of time so oil warms and penetrates the gap between the inside and outside plates of roller chains.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Replace drive chain.

ENABLER

1. Recall hand tool safety.
2. Read maintenance instructions.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to replace drive chain.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified type of drive chain and location.	________	________
2.	Removed chain from drive sprocket.	________	________
3.	Inspected chain and sprockets.	________	________
4.	Aligned shafts and sprockets.	________	________
5.	Installed drive chain on sprockets.	________	________
6.	Adjusted drive chain tension.	________	________
7.	Installed all chain guards and shields in place prior to operation.	________	________
8.	Lubricated the chain.	________	________
9.	Ran chain drive for a short period of time so oil warmed and penetrated the gap between the inside and outside plates of roller chains.	________	________

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 133

TASK: Replace broken or stripped gears.

STANDARD OF PERFORMANCE OF TASK:

Gears must mesh together and provide torque to rotating parts without slippage or loss of power.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Service: Power Trains.
Fundamentals of Service: Identification of Parts Failure.
Fundamentals of Machine Operation: Preventive Maintenance.

CONDITIONS FOR PERFORMANCE OF TASK:

Tool kit
Replacement gear
Maintenance instructions

ENABLING OBJECTIVES:

1. Recall hand tool safety.
2. Read maintenance instructions.

***RESOURCES:**

1. John Deere Service Publications. (1979). Fundamentals of service: Power trains (4th ed.). Moline, IL: Author.
2. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
3. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.
5. Maintenance instructions.
6. Checklist - Replacing broken or stripped gears.

TEACHING ACTIVITIES:

1. List pieces of equipment that have gears. (* 1)
2. Question students on problems associated with inadequate adjustments of gears or worn/damaged gears.
3. Show examples of types of gears systems.
4. Show examples of inadequately adjusted gears.
5. Show examples of worn/damaged gears.
6. Show examples of maintenance instructions. (* 5)
7. List types of gear retainers. (* 1,2,3,4 & 5)
8. Demonstrate how to remove gear retainers. (* 1,2,3,4 & 5)
9. Demonstrate how to remove the gear from the shaft using a gear puller. (* 1,2,3,4 & 5)
10. Present lecture on the inspection of the gear and the shaft. (* 1,2,3,4 & 5)
11. Question students on the condition of the removed gear and the shaft.
12. Demonstrate how to install a new gear on the shaft.
13. Demonstrate how to align and adjust the gear.
14. Demonstrate how to secure the gear retainer in place.
15. Demonstrate how to lubricate the gear.
16. Discuss the importance of replacing shields and guards.
17. Monitor students as they practice replacing broken or stripped gears.
18. Assign each student a piece of equipment for which to replace the broken or stripped gears. (* 6)

CRITERION-REFERENCED MEASURE:

The student must remove the gear, install a new gear if needed, or reinstall the gear, align and adjust the gear and lubricate the gear. The student must explain the reasons for installing a new gear or reinstalling the gear, adjustment and alignment must meet the manufacturer's specifications (gears must not slip) and all guards and shields must be replaced.

PERFORMANCE GUIDE:

1. Identify type and location of gear.

PERFORMANCE GUIDE: (cont.)

2. Inspect gears for:
    A. Damage:
        1. Breaks (missing teeth).
        2. Pitting, spalling, case crushing (chips).
        3. Fatigue (cracks).
        4. Excessive wear:
            a. Adhesive.
            b. Abrasive.
            c. Corrosive.
        5. Ripping, ridging, and cold flow.
    B. Gear adjustment:
        1. Backlash.
        2. Endplay.
        3. Preload.
3. Remove gear retainer:
    A. Key.
    B. Set screw.
    C. Collar.
    D. Pin.
    E. Clip.
4. Remove damage gear from shaft using gear puller.
5. Inspect gear shaft for damage:
    A. Warped.
    B. Scarred.
    C. Burred.
    D. Twisted.
6. Obtain new gear.
7. Install gear on shaft.
8. Align and adjust gear.
9. Secure gear retainer in place.
10. Lubricate gear:
    A. Brush on oil.
    B. Use oil can.
    C. Automatic drip oiler.
11. Replace shields.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Replace broken or stripped gears.

ENABLER

1. Recall hand tool safety.
2. Read maintenance instructions.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to replace broken or stripped gears.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified type and location of gear.	_______	_______
2.	Inspected gears:		
	- Damage	_______	_______
	- Gear adjustment	_______	_______
3.	Removed gear retainer.	_______	_______
4.	Removed damaged gear from shaft.	_______	_______
5.	Inspected gear shaft for damage.	_______	_______
6.	Obtained new gear.	_______	_______
7.	Installed gear on shaft.	_______	_______
8.	Aligned and adjusted gear.	_______	_______
9.	Secured gear retainer in place.	_______	_______
10.	Lubricated gear.	_______	_______
11.	Replaced shields.	_______	_______

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 134

TASK: Lubricate equipment.

STANDARD OF PERFORMANCE OF TASK:

Type of lubricant and frequency of lubrication must be in accordance with manufucturer's maintenance specifications.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Lubricant
Brush
Grease
Tool kit
Grease gun
Grease stick
Oil can/dispenser
Equipment to be serviced

ENABLING OBJECTIVES:

1. Read maintenance schedule.
2. Identify equipment by name or identification number.
3. Recall hand tool safety.
4. Write, print or type information on maintenance records.

***RESOURCES:**

1. John Deere Service Publications. (1973). Fundamentals of machine operation: Preventive maintenance. Moline, IL: Author.
2. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Brown, A., & Strickland, R. (1973). Tractor and small engine maintenance. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

4. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.
5. Maintenance schedule.
6. Manufacturer's service instructions.
7. Checklist - Lubricating equipment.

TEACHING ACTIVITIES:

1. Question students on the importance of lubricating equipment on a timely basis.
2. List pieces of equipment that require lubrication. (* 1,2,3,4 & 6)
3. List lubrication required (parts, how often) for the listed equipment. (* 1,2,3,4 & 6)
4. Show resources available to help determine the type of grease/oil to use. (* 1,2,3,4 & 6)
5. Assign students to look up the lubrication requirements of a piece of equipment. (* 1,2,3,4,5,6 & 7)
6. Show examples of parts that require lubrication and discuss the type of lubricant used for each type of part.
7. Show a piece of equipment that is sticking, jamming or showing wear at the point of lubrication.
8. Assign students to disassemble a piece of equipment for the purpose of accessing the points of lubrication.
9. Demonstrate how to apply the lubricant.
10. Monitor students as they practice applying lubricant.
11. Question students on how to distribute the lubricant.
12. Assign students to wipe off the excess lubricant.
13. Assign students to reassemble the piece of equipment.
14. Assign students to record the work performed in the maintenance schedule. (* 7)
15. Assign each student a piece of equipment to lubricate. (* 7)

CRITERION-REFERENCED MEASURE:

The student must look up and list the lubrication required (part, how often) disassemble the piece of equipment as needed, lubricate the part(s), reassemble the piece of equipment and record the work performed. The listed lubrication requirements must be the same as is recommended,

CRITERION-REFERENCED MEASURE: (cont.)

all parts that require lubricating must exhibit fresh grease or oil, all excess grease/oil must be removed, the equipment must be reassembled according to manufacturer's specifications, and the information recorded in the maintenance schedule must be complete and legible.

PERFORMANCE GUIDE:

1. Review maintenance schedule and determine equipment due for lubrication.
2. Assemble equipment due for lubrication or equipment which is sticking, jamming or showing wear.
3. Disassemble equipment so part to be lubricated is accessible.
4. Determine type of part to be lubricated and type of lubricant needed.
   A. Grease:
      1. Packed bearings.
      2. Sliding parts.
      3. Rotating cams.
      4. Grease fittings.

   B. Oil:
      1. Enclosed gears.
      2. Open drive gears.
      3. Bearings.
      4. Oil reservoirs.
      5. Pulleys.
      6. Cable guides.
      7. Pivot points.
      8. Shaft sliding through bushing.
5. Apply lubricant to part to be lubricated:
   A. Oil:
      1. Oil can.
      2. Brush.
      3. Spout.

   B. Grease:
      1. Brush.
      2. Grease stick.
      3. Grease gun.
6. Move part back and forth to distribute lubricant if possible.
7. Wipe off excess lubricant.
8. Reassemble equipment and record on maintenance schedule.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Lubricate equipment.

ENABLER

1. Read maintenance schedule.
2. Identify equipment by name or identification number.
3. Recall hand tool safety.
4. Write, print or type information on maintenance records.

STUDENT'S NAME ______________________________ **DATE** __________

EVALUATOR'S NAME ____________________________ **COURSE** ________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to lubricate equipment.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified equipment due for lubrication.		
2.	Assembled equipment due for lubrication or equipment which was sticking, jamming or showing wear.		
3.	Disassembled equipment so part to be lubricated was accessible.		
4.	Identified type of part to be lubricated and type of lubricant needed.		
5.	Applied lubricant to part to be lubricated.		
6.	Moved part back and forth to distribute lubricant if possible.		
7.	Wiped off excess lubricant.		
8.	Reassembled equipment and recorded works on maintenance schedule.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 135

TASK: Service drive belts.

STANDARD OF PERFORMANCE OF TASK:

Drive belts must not slip, squeak, squeal or be damaged.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Service: Belts and Chains.
Fundamentals of Service: Identification of Parts Failure.
Fundamentals of Machine Operation: Preventive Maintenance.

CONDITIONS FOR PERFORMANCE OF TASK:

Ruler
Pry bar
Tool kit
Gear puller
Spring scale
Belt dressing
Straight edge
Replacement belt/belt set
Maintenance instructions

ENABLING OBJECTIVES:

1. Recall hand tool safety.
2. Read maintenance instructions.

***RESOURCES:**

1. John Deere Service Publications. (1980). Fundamentals of service: Belts and chains (3rd ed.). Moline, IL: Author.
2. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
3. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers and Publishers, Inc.

***RESOURCES:** (cont.)

4. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.
5. Maintenance instructions.
6. Checklist - Servicing drive belts.

TEACHING ACTIVITIES:

1. List pieces of equipment that have drive belts. (* 1)
2. Question students on problems associated with inadequate adjustments of belts worn/damaged belts.
3. Show examples of types of belt drive systems.
4. Show examples of pulleys and/or sheaves.
5. Show examples of worn/damaged belts.
6. Show examples of maintenance instructions. (* 5)
7. Demonstrate how to remove shields and guards. (* 1,2,3,4 & 5)
8. Demonstrate how to release the tension on a belt and remove the belt.
9. Discuss the importance of not forcing the belt with a pry bar.
10. Present lecture on the inspection of belts. (* 1,2,3,4 & 5)
11. Question students on the condition of the removed belt and pulley/sleeve.
12. Present lecture on determining belt size.
13. Demonstrate how to install a new belt.
14. Demonstrate how to adjust the belt tension.
15. Discuss the importance of replacing shields and guards.
16. Monitor students as they practice servicing drive belts.
17. Assign each student a piece of equipment for which to service the drive belt(s). (* 6)

CRITERION-REFERENCED MEASURE:

The student must remove the drive belt, inspect the belt and pulley/sheave, record the belt size, install a new belt if needed, or reinstall the belt and adjust the belt tension. The student must explain the reasons for installing a new belt or reinstalling the belt, adjust the belt tension according to the manufacturer's specifications (drive belts must not slip, squeak, squeal or be damaged) and all guards and shields must be replaced.

PERFORMANCE GUIDE:

1. Identify type and location of drive belt to be serviced.
2. Identify type of belt drive system:
   - A. Open.
   - B. Turned.
   - C. Crossed.
   - D. Serpentine.
   - E. Mule.
3. Remove belt guides and shields.
4. Release tension from drive belt or loosen mounting belts and slide drive forward.
5. Remove belt from pulley/sleeve.
   CAUTION: Never use a pry bar to remove or install a belt.
6. Inspect drive belt for:
   - A. Base cracking.
   - B. Fabric rupture.
   - C. Cover tear.
   - D. Slip burn.
   - E. Gouged edge.
   - F. Ruptured cords.
   - G. Worn sides.
   - H. Excessive stretch.
   - I. Belt size.
   - J. Separation.
   - K. Holes/blister.
7. Obtain new drive belt (if necessary).
8. Determine type of pulley/sheave.
9. Inspect pulley/sheave:
   - A. Groove/groove bottom.
   - B. Chips.
   - C. Bends.
   - D. Grease/oil.
   - E. Wear "dished out".
   - F. Wobble.
10. Replace drive belt:
    - A. Identify correct sized belt.
    - B. Loosen drive mounting bolts and slide the drive forward.
    - C. Drop belt over the sheave.
      CAUTION: Never force a belt over a sheave using a pry bar or screwdriver. It is dangerous and damages the belt cords.
    - D. Return drive to original position and tighten mounting bolts.

PERFORMANCE GUIDE: (cont.)

- E. Adjust belt tension:
  1. Check belt tension by deflecting the belt on one side with a spring scale.
  2. Place a straight edge across the two sheaves.
  3. Depress the belt halfway between the sheaves using a ruler at right angles to the straight edge.
  4. Make needed adjustments.

11. Replace all guards and shields in their proper locations.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Service drive belts.

ENABLER

1. Recall hand tool safety.
2. Read maintenance instructions.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to service drive belts.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Identified type and location of drive belt to be serviced.		
2. Removed belt guides and shields.		
3. Inspected drive belt.		
4. Listed size of new drive belt.		
5. Inspected pulley/sheave.		
6. Replaced drive belt.		
7. Adjusted belt tension.		
8. Replaced all guards and shields.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 136

TASK: Clean equipment.

STANDARD OF PERFORMANCE OF TASK:

Equipment must be free from dirt, grease and foreign matter.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Machine Operation: Preventive Maintenance.

CONDITIONS FOR PERFORMANCE OF TASK:

Pail
Soap
Wire brush
Putty knife
Paintbrush
Cleaning rags
Screwdriver
Small spray gun
High pressure sprayer
Commercial de-greaser (solvent)
Water hose equipped with nozzle
Face, eye, and hand protection

ENABLING OBJECTIVES:

1. Recall equipment safety.
2. Recall cleaning equipment and cleaning solvent safety.
3. Recall parts that require special access.
4. Determine if dirt, grease and foreign matter is removed.
5. Determine parts that require presence of grease.

***RESOURCES:**

1. John Deere Service Publications. (1980). Fundamentals of service: Mowing and spraying equipment (5th ed.) Moline, IL: author.
2. Cooper, Elmer, L. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.

***RESOURCES:** (cont.)

3. Checklist - Cleaning equipment.

TEACHING ACTIVITIES:

1. Show examples of equipment that needs cleaned.
2. Show parts to be cleaned. (* 1 & 2)
3. Show how to access parts that need to be cleaned. (* 1)
4. Discuss the importance of cleaning equipment.
5. Question students on cleaning equipment safety.
6. Show tools, equipment, and materials, used to clean equipment.
7. Demonstrate how to prepare equipment for cleaning.
8. Demonstrate how to remove heavy accumulations of grease, grime, and dirt.
9. Demonstrate how to apply solvents.
10. Demonstrate how to remove solvents.
11. Question students on whether or not the equipment is free of dirt, grease and foreign matter.
12. Monitor students as they practice cleaning equipment.
13. Demonstrate how to replace any removed parts.
14. Assign each student a piece of equipment to clean. (* 3)

CRITERION-REFERENCED MEASURE:

The student must prepare the piece of equipment for cleaning, remove all dirt, grease and foreign matter and replace any removed parts. The piece of equipment must be free from dirt, grease, and foreign matter (not more than 1% of surface area not clean).

PERFORMANCE GUIDE:

1. Allow machine to cool, if it has been running.
   NOTE: A hot engine will evaporate the cleaning solvent, but an engine that is warm to touch can be cleaned more easily.
2. Remove hood, side panel and any guards necessary to reach accumulated dirt.
3. Remove heavy accumulations of grease, grime, and dirt using a putty knife.
4. Apply solvent on areas that need cleaning:
   A. Brush on.
   B. Paint sprayer.

PERFORMANCE GUIDE: (cont.)

    - C. Insect spray gun.
    - D. Pressurized/aerosol can.
      NOTE: Let solvent soak for approximately 15 minutes to allow penetration and loosening of grease and oil particles.
5. Remove solvent from equipment surface:
    - A. Degreaser:
        1. Spray a strong stream of water from hose or high pressure sprayer.
        2. Continue to flush surface until all milky substances are removed.
           CAUTION: Avoid spraying into vents and air intakes.
    - B. Diesel fuel:
        1. Apply a strong soap solution with a paintbrush.
        2. Flush surface area with stream of water.
6. Check for areas that were missed:
    - A. Use a wire brush and rag to clean accumulations that did not flush off.
7. Replace hood, sides and guard removed originally.
8. Wipe equipment surface dry if desired.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Clean equipment.

ENABLER

1. Recall equipment safety.
2. Recall cleaning equipment and cleaning solvent safety.
3. Recall parts that require special access.
4. Determine if dirt, grease and foreign matter is removed.
5. Determine parts that require presence of grease.

STUDENT'S NAME____________________ **DATE**__________

EVALUATOR'S NAME____________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to clean equipment.

PERFORMANCE DETERMINANTS	YES	NO
1. Prepared equipment for cleaning.	______	______
2. Removed heavy accumulations of grease, grime, and dirt using putty knife.	______	______
3. Applied solvent.	______	______
4. Allowed solvent to soak.	______	______
5. Removed solvent.	______	______
6. Checked for complete removal of dirt, grease, and foreign matter.	______	______
7. Replaced any removed parts.	______	______
8. Cleaned area in which equipment was cleaned.	______	______

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 137

TASK: Maintain pesticide applicator.

STANDARD OF PERFORMANCE OF TASK:

Spraying equipment must be cleaned and calibrated for specific crop, according to manufacturer's recommendations.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Fundamentals of Service: Mowing and Spraying Equipment.

CONDITIONS FOR PERFORMANCE OF TASK:

Tape measure
Replacement parts
Watch with second hand
Sprayer calibration chart
Spraying equipment tool kit
Maintenance instructions
Graduated measuring containers (milliliters, liter)

ENABLING OBJECTIVES:

1. Recall pesticide safety.
2. Recall factors to consider in sprayer type selection.
3. Recall factors to consider in sprayer nozzle selection.
4. Identify pesticide residue.
5. Pressurize sprayer equipment.
6. Recall units of measurement.

***RESOURCES:**

1. John Deere Service Publications. (1980). Fundamentals of service: Mowing and spraying equipment (5th ed.) Moline, IL: author.
2. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.
3. Checklist - Maintaining a pesticide applicator.

TEACHING ACTIVITIES:

1. Discuss the importance of pesticide applicator maintenance.
2. Question students on pesticide safety.
3. Show several examples of sprayers.
4. Outline procedures used to maintain pesticide applicator. (* 1 & 2)
5. Show several examples of cracks in tanks, hoses and/or booms, leaky connections, pesticide residue, clogged spray nozzles and wool or defective spray nozzle parts.
6. Demonstrate how to fill and pressurize the supply tank.
7. Demonstrate how to inspect supply tanks, hoses, booms and spray nozzles while the sprayer is operating under pressure.
8. Demonstrate the effect on flow and droplets of increasing the pressure.
9. Question the students on the relationship between pressure and flow.
10. Question students on the relationship between pressure and droplet size.
11. Question students on the relationship between pressure and spray pattern.
12. Assign students to collect spray from each nozzle for a specified period of time.
13. Assign students compare the samples taken from each nozzle.
14. Question students on the operational condition of each nozzle/top.
15. Demonstrate how to clean and/or replace nozzles/tops.
16. Monitor students as they practice cleaning and/or replacing nozzles/tips.
17. Monitor students as they practice pressurizing the supply tank.
18. Monitor students as they practice measuring and adjusting the flow rate/droplet size.
19. Assign each student a pesticide applicator to maintain. (* 3)

CRITERION-REFERENCED MEASURE:

The student must inspect the supply tank, hoses, booms and nozzles, adjust the pressure and compare the output of the individual nozzles. Any cracks, leaks, holes, residues, clogged or defective nozzles or tips must be identified and the pressure must produce the desired flow, droplet size and spray pattern.

PERFORMANCE GUIDE:

1. Identify type of sprayer:
    A. Power boom sprayer.
    B. Power hand-held sprayer.
    C. Manual hand-held sprayer.
    D. Subsoil application sprayer.
2. Inspect supply tank:
    A. Check for cracks.
    B. Check for connection leaks.
    C. Check for left-over residue.
3. Inspect hose and booms:
    A. Check for cracks.
    B. Check for holes.
    C. Check for connection leaks.
4. Identify type of spray nozzle to be used:
    A. Centrifugal nozzle.
    B. Flooding nozzle.
    C. Two-fluid nozzle.
    D. Rotary atomizer.
5. Inspect each spray nozzle for clogging or defective parts:
    A. Nozzle body.
    B. Nozzle strainer.
    C. Nozzle tip.
    D. Nozzle cap.
6. Adjust sprayer:
    A. Flow rate:
        1. The higher the pressure, the higher the flow rate.
           NOTE: To double the flow rate, the pressure must be increased four times. Conversely to decrease the flow rate by half, the pressure must be reduced to one-fourth of the original pressure.
    B. Atomization:
        1. Low pressure - Large droplets.
        2. High pressure - Smaller drops.
    C. Pre-Calibration:
        1. Install clean water in supply tank.
        2. Operate the sprayer at pressure setting indicated by nozzle tip calculator; check for leaks and spray pattern.
        3. Collect the spray from each nozzle tip in graduated containers for the same period of time (15-30 seconds).
        4. Record the sample from each nozzle.

PERFORMANCE GUIDE: (cont.)

5. Replace tips if rate or spray patterns are not correct.
   CAUTION: Horticultural chemicals can be dangerous to persons, animals, plants and soil. Recommended protective clothing; caps, gloves, respirator, goggles and footwear must be used at all times.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Maintain pesticide applicator.

ENABLER

1. Recall pesticide safety.
2. Identify pesticide residue.
3. Pressurize sprayer equipment.
4. Recall units of measurement.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain a pesticide applicator.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Checked for pesticide and/or pesticide residue.		
2.	Identified all cracks.		
3.	Identified all leaks.		
4.	Identified all holes.		
5.	Identified clogged nozzles.		
6.	Identified defective nozzles.		
7.	Identified clogged tips.		
8.	Identified defective tips.		
9.	Filled supply tank.		
10.	Adjusted pressure for desired flow.		
11.	Adjusted pressure for desired droplet size.		
12.	Adjusted pressure for desired spray pattern.		
13.	Timed the collection of spray pattern.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
14.	Recorded volume of spray samples.		
15.	Identified nozzles with above or below average flow rate.		
16.	Cleaned clogged nozzles/tips.		
17.	Replaced defective nozzle/tips.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 138

TASK: Maintain growing structure heating system.

STANDARD OF PERFORMANCE OF TASK:

The heating system must be inspected daily during the heating season and operate at optimum efficiency for particular heating system. Routine maintenance must be performed as recommended by manufacturer's maintenance schedule.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Thermometer
Tool box
Muriatic acid
Wire brush
Pipe cutter
Pipe wrench
Pipe threader

ENABLING OBJECTIVES:

1. Read heating system maintenance instructions.
2. Recall hand tool safety.
3. Recognize improperly operating heating system.

***RESOURCES:**

1. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
2. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
3. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
4. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
5. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
6. Heating system maintenance instructions.
7. Checklist - Maintaining growing structure heating system.

TEACHING ACTIVITIES:

1. Question students on the possible results of inadequate maintenance of the heating system.
2. List types of a growing structure heating systems. (* 1,2,3,4 & 5)
3. List advantages and/or disadvantages of the listed heating systems.
4. List components of the listed systems that need to be inspected. (* 6)
5. Present lecture on problems inherent to the listed heating systems. (* 1,2,3,4,5 & 6)
6. Present lecture on components that are routinely checked. (* 1,2,3,4,5 & 6)
7. Present lecture on safety precautions to take when checking or maintaining the heating systems.
8. Demonstrate how to perform routine maintenance operations. (* 6)
9. Demonstrate how to record work performed.
10. Question students on hand tool safety.
11. List reference materials available to help maintain growing structure heating systems. (* 1,2,3,4,5 & 6)
12. Assign each student a period of time during which to maintain a growing structure heating system. (* 7)

CRITERION-REFERENCED MEASURE:

The student must inspect the heating system, perform routine maintenance operations and repair or replace malfunctioning components. The heating system must be inspected daily during the heating season and operate at optimum efficiency for particular heating system. Routine maintenance must be performed as recommended by manufacturer's maintenance schedule.

PERFORMANCE GUIDE:

1. Identify type of heating system being utilized in growing structure:
    - A. Hot water circulating system.
    - B. Steam heating system.
    - C. Forced air heating system.
    - D. Infrared heating system.
2. Inspect specified heating system:
    - A. Check and adjust thermostatic controls.
    - B. Check and adjust circulatory fans.
    - C. Check burners or pilot light.
    - D. Check exhaust system.

PERFORMANCE GUIDE: (cont.)

- E. Check pumps.
- F. Check water or steam pipes and valves:
    - 1. Inspect for dirt, rust, or chemical residue.
        - a. Disassemble pipes into sections.
        - b. Clean pipes:
            - 1. Pull wire brush through the pipes by a chain.
            - 2. Apply muriatic acid to inside of pipe.
        - c. Assemble pipes back together.
    - 2. Replace broken pipes:
        - a. Remove broken pipe.
        - b. Cut pipe to specified length using a pipe cutter.
        - c. Thread pipe using a pipe threader.
        - d. Assemble pipes.
        - e. Replace defective parts.
    - 3. Repair or replace defective valves.

3. Check for pollutants such as ethylene and other gases.
4. Perform routine maintenance according to manufacturer's recommended maintenance schedule.
5. Record work performed in maintenance records.
6. Call service representative or repair person if system malfunctions.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Maintain growing structure heating system.

ENABLER

1. Read heating system maintenance instructions.
2. Recall hand tool safety.
3. Recognize improperly operating heating system.

STUDENT'S NAME________________________ **DATE**__________

EVALUATOR'S NAME________________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain growing structure heating system.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed type of heating system being utilized in growing structure.	____	____
2. Inspected specified heating system:		
- Checked and adjust thermostatic controls.	____	____
- Checked and adjust circulatory fans.	____	____
- Checked burners or pilot light.	____	____
- Checked exhaust system.	____	____
- Checked pumps.	____	____
- Checked water or steam pipes.	____	____
- Checked valves.	____	____
3. Replaced broken pipes.	____	____
4. Replaced defective controls.	____	____
5. Checked for pollutants.	____	____

PERFORMANCE DETERMINANTS (cont.)	YES	NO
6. Recorded worked performed.	________	________
7. Performed routine maintenance according to manufacturer's recommended maintenance schedule.	________	________

PERFORMANCE OBJECTIVE NO. 139

TASK: Maintain growing structure cooling system.

STANDARD OF PERFORMANCE OF TASK:

Fan/pad cooling system maintenance must include inspection and needed adjustments to pads, pump system, fans, and thermostats. Fog system maintenance must include inspection and needed adjustments to filters, nozzles, control systems, and chlorination of water. Fan/jet cooling system maintenance must include inspection and needed adjustments to polyethylene tubes, exhaust fans, thermostats, and shutters.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Hose
Tool box
Algaecide
Wrenches
Thermometer
Fan/jet cooling system
Fan/pad cooling system

ENABLING OBJECTIVES:

1. Read cooling system maintenance instructions.
2. Recall hand tool safety.
3. Recognize improperly operating cooling system.

***RESOURCES:**

1. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
2. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.
3. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
4. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.

***RESOURCES:** (cont.)

5. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
6. Cooling system maintenance instructions.
7. Checklist - Maintaining growing structure cooling system.

TEACHING ACTIVITIES:

1. Question students on the possible results of inadequate maintenance of the cooling system.
2. List types of a growing structure cooling systems. (* 1,2,3,4 & 5)
3. List the advantages and disadvantages of the listed cooling systems.
4. List components of the listed systems that need to be inspected. (* 6)
5. Present lecture on problems inherent to the listed cooling systems. (* 1,2,3,4,5 & 6)
6. Present lecture on components that are routinely checked. (* 1,2,3,4,5 & 6)
7. Present lecture on safety precautions to take when checking or maintaining a cooling system.
8. Demonstrate how to perform routine maintenance operations. (* 6)
9. Demonstrate how to record work performed.
10. Question students on hand tool safety.
11. List reference materials available to help maintain growing structure cooling systems. (* 1,2,3,4,5 & 6)
12. Assign each student a period of time during which to maintain a growing structure cooling system. (* 7)

CRITERION-REFERENCED MEASURE:

The student must inspect the cooling system, perform routine maintenance operations and repair or replace malfunctioning components. The cooling system must be inspected daily during the cooling season and operate at optimum efficiency for particular cooling system. Routine maintenance must be performed as recommended by manufacturer's maintenance schedule.

PERFORMANCE GUIDE:

1. Identify type of cooling system being utilized:
   A. Fan/pad cooling system:

PERFORMANCE GUIDE: (cont.)

1. Inspect fan/pad cooling system in winter to determine maintenance required before warm weather:
   NOTE: Follow manufacturer's recommended maintenance procedures.
   a. Check pads to determine if replacement is required:
      1. Aspen pads.
      2. Paper pads.
      3. Concrete pads.
      4. Aluminum pads.
   b. Check circulating pump system.
   c. Check exhaust fans:
      1. Tighten belts to eliminate any slippage.
      2. Check fan shutters.
   d. Check thermostat control system.
2. Inspect cooling system daily during operation:
   a. Check pad area to insure pad area is kept completely wet without any dry spots.
   b. Check pad for algae growth.
   c. Maintain recommended level of algaecide in circulating water.
   d. Check thermostat and temperature.
   e. Check greenhouse for air leaks.
3. Perform winter maintenance on cooling system:
   a. Drain water tanks and lines.
   b. Check fan and inlet shutters for air leaks.
   c. Remove pads if recommended for particular type of pad.

B. Fog system:
   NOTE: Follow manufacturer's recommended maintenance procedures.
   1. Inspect and clean filters.
   2. Regulate the chlorine content in water.
   3. Inspect and clean nozzles:
      a. Spinning type atomizer.
      b. Jet atomizer.
      c. Direct pressure mechanical atomizer.
   4. Check control system.

C. Fan/jet cooling system:
   1. Inspect polyethylene tube for wear.
   2. Check exhaust fans:
      a. Tighten belts to eliminate any slippage.
      b. Check fan shutters.

PERFORMANCE GUIDE: (cont.)

        3. Inspect air inlet shutters.
        4. Check thermostat control system.
    D. Replace defective parts.
2. Record work performed.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Maintain growing structure cooling system.

ENABLER

1. Read cooling system maintenance instructions.
2. Recall hand tool safety.
3. Recognize improperly operating cooling system.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME____________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to maintain a growing structure cooling system.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Identified cooling system by name and type.		
Fan/pad cooling system:		
2. Performed maintenance required before warm weather:		
- Checked pads.		
- Checked circulating pump system.		
- Checked exhaust fans.		
- Tightened belts.		
- Checked fan shutters.		
- Checked thermostat control system.		
3. Inspected cooling system daily during operation:		
- Checked pads wetness.		
- Checked pad for algae growth.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
- Maintained recommended level of algaecide in circulating water.		
- Checked thermostat and temperature.		
- Checked greenhouse for air leaks.		
4. Performed winter maintenance on cooling system:		
- Turned off power to pumps.		
- Drained water tanks and lines.		
- Checked fan and inlet shutters for air leaks.		
- Removed pads.		
Fog system:		
5. Inspected and cleaned filters.		
6. Regulated the chlorine content in water.		
7. Inspected and cleaned nozzles.		
8. Checked control system.		
Fan/jet cooling system:		
9. Inspected polyethylene tube for wear.		
10. Checked exhaust fans.		
11. Tightened belts.		
12. Checked fan shutters.		
13. Inspected air inlet shutters.		
14. Checked thermostat control system.		
15. Replaced defective parts.		
16. Recorded work performed.		

DUTY: PERFORMING MAINTENANCE OPERATIONS

PERFORMANCE OBJECTIVE NO. 140

TASK: Order repair parts for equipment.

STANDARD OF PERFORMANCE OF TASK:

Purchase order must include name of part, part number, quantity, method of shipping, vendor name and address, and authorization.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Order forms
Maintenance/repair manual
Equipment part to be replaced

ENABLING OBJECTIVES:

1. Read maintenance/repair manual.
2. Recall methods of shipping available.
3. Write, print, or type information on order form.
4. File records according to system.

***RESOURCES:**

1. Maintenance repair manual.
2. Equipment parts catalog.
3. Purchase order form.
4. Checklist - Ordering repair parts for equipment.

TEACHING ACTIVITIES:

1. Question students on their experiences regarding ordering repair parts for automobiles, appliances or other equipment.
2. Outline procedures used to order repair parts for equipment.
3. Show examples of parts that need to be replaced.
4. Question students on the names of the parts.
5. List resources available to help determine the name of the parts. (* 1 & 2)
6. Demonstrate how to determine the name of the part and the part number. (* 1 & 2)

TEACHING ACTIVITIES: (cont.)

7. Questions students on the methods of shipping available.
8. Show examples of purchase order forms. (* 3)
9. Demonstrate how to complete the purchase order form. (* 3)
10. Discuss the importance of obtaining authorization for purchases.
11. Question students on methods of submitting the order.
12. Assign each student a list of repair parts to order. (* 4)

CRITERION-REFERENCED MEASURE:

The student must describe the repair parts, complete the purchase order form, submit the order to the test administrator and file the records. The description of the repair parts must include all required information (order can be filled without additional information) and records must be accurate, legible and filed according to system.

PERFORMANCE GUIDE:

1. Identify repair part needed:
    - A. Locate repair part in maintenance/repair manual.
    - B. Contact distributor.
2. Complete purchase order:
    - A. Name of part.
    - B. Part number.
    - C. Quantity needed.
    - D. Method of shipping.
    - E. Vendor name and address.
3. Obtain authorization for purchase.
4. Submit order in person, by mail, or telephone.
5. File copy of the order.

CHECKLIST

DUTY Performing Maintenance Operations

TASK Order repair parts for equipment.

ENABLER

1. Read maintenance/repair manual.
2. Recall methods of shipping available.
3. Write, print, or type information on order form.
4. File records according to system.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to order repair parts for equipment.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified repair part needed.	______	______
2. Completed purchase order:		
- Name of part.	______	______
- Part number.	______	______
- Quantity needed.	______	______
- Method of shipping.	______	______
- Vendor name and address.	______	______
3. Obtained authorization for purchase.	______	______
4. Submitted order in person, by mail, or telephone.	______	______
5. Filed copy of the order.	______	______

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 141

TASK: Collect seeds.

STANDARD OF PERFORMANCE OF TASK:

Seeds must be mature. Harvested fruit must be placed in storage containers and labeled with plant species, date, and location of mother plant.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Bags
Poles
Labels
Knives
Clippers
Tarpaulin
Cone hooks
Containers
Plants with mature seeds

ENABLING OBJECTIVES:

1. Recall harvesting tool and equipment safety.
2. Identify plant species.
3. Identify the mature seeds and/or fruit of plants.
4. Label plant containers.

***RESOURCES:**

1. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
2. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.
3. Symonds, G. (1963). The shrub identification book. Fort Atkinson, WI: Nasco.
4. Dirr, M. (1983). Manual of woody landscape plants: their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes.
5. Checklist - Collecting seeds.

TEACHING ACTIVITIES:

1. Present lecture on a hypothetical or real situation in which seed collect is practical or required.
2. List people or organization who could provide plants from which seeds could be collected. (* 1)
3. List places where seeds could be collected.
4. Show examples of plants with seeds that are and are not mature. (* 2,3 & 4)
5. Demonstrate how to remove seeds from plants.
6. Demonstrate how to place seeds or fruits in a container.
7. Question students on what information should be included on the container label.
8. Demonstrate how to label the container.
9. Question students on safety considerations regarding the tools used to remove seeds from the plants.
10. Monitor students as they practice selecting plants with mature seeds.
11. Monitor students as they practice removing seeds from the mature plants they have selected.
12. Assign each student an area and/or plant species for seed collection. (* 5)

CRITERION-REFERENCED MEASURE:

The student must locate a plant with mature seeds that is of the desired species, remove the seeds, place the seeds in a container and label the container. The collected seeds must be mature seeds of the desired species (greater than 75% of seeds capable of germination), placed in a storage container (seeds not mixed with other seeds) which is labeled (plant's species, date, and location of the mother plant).

PERFORMANCE GUIDE:

1. Select source of seed:
   A. Trees and shrubs seed:
      1. Search for native species in natural stands in forests:
         a. Select standing trees.
         b. Select trees felled from logging operations.
         c. Select seeds from squirrel caches.
      2. Select wanted species from parks, roadways, or woodlots.
      3. Select wanted species from seed orchards.

PERFORMANCE GUIDE: (cont.)

4. Select wanted species from garden club members, plant society members, and plant enthusiasts.

B. Herbaceous seed:

1. Search for wild or native species:
   a. Select plants from forests, prairies, meadows, or swamplands.
   b. Select plants from railroad and highway right-of-ways.
2. Select wanted species from parks and gardens.
3. Select wanted species from garden club members, plant society members, and plant enthusiasts.

2. Select plants with mature seeds.

NOTE: Harvesting should be done after seeds mature, but before seeds shatter, drop off, or are eaten by wildlife.

3. Remove seeds from plant:

A. Plants with dry fruits:

1. Remove dry seeds and fruits from plants as soon as they mature.
2. Cut dry seeds and fruits from plant.
3. Shake or knock dry seeds and fruits from plant.
   NOTE: A tarpaulin may be placed under plants to catch the seeds.
4. Hook cones using cone hooks.
5. Pick seeds and fruits by hand.

B. Plants with fleshy fruits:

1. Remove fleshy fruits when ripe or overripe according to recommendations for particular plant species.
2. Cut fleshy fruits from plant.
3. Shake or knock fleshy fruits from plant.
4. Pick fleshy fruits by hand.

4. Place fruits of each particular species in specified bag or container.
5. Label the container with plant species, date, and location of mother plant.

CHECKLIST

DUTY Harvesting Plants

TASK Collect seeds.

ENABLER

1. Recall harvesting tools and equipment safety.
2. Identify plant species.
3. Identify the mature seeds and/or fruit of plants.
4. Label plant containers.

STUDENT'S NAME ____________________ **DATE** __________

EVALUATOR'S NAME ____________________ **COURSE** __________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to collect seeds.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Used harvesting equipment safety.	______	______
2.	Located plant(s) of desired species.	______	______
3.	Determined if seeds were mature.	______	______
4.	Removed mature seeds or fruits from the plant.	______	______
5.	Placed seeds or fruits in a container.	______	______
6.	Avoided placing unwanted plant refuse or other debris in the container.	______	______
7.	Avoided placing insects in the container.	______	______
8.	Avoided seeds or fruit with visual evidence of pathogens present.	______	______
9.	Labeled the container with species, date, and location of the mother plant.	______	______

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 142

TASK: Clean seeds.

STANDARD OF PERFORMANCE OF TASK:

Seeds must be extracted from fruit, cleaned, dried and separated without damage to the seed coat of embryo.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Practices and Principles.

CONDITIONS FOR PERFORMANCE OF TASK:

Screens
Tumblers
Macerator
Dewinging machine
Pneumatic separator
Fruits harvested for seed

ENABLING OBJECTIVES:

1. Measure kiln temperature.
2. Estimate and or measure moisture content of seeds.

***RESOURCES:**

1. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
2. Harness, & D'Angelo. (1987) The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.
3. Bubel, N. (1978) Seed-starter's handbook. Emmaus, PA: Rodale Press.
4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
5. Checklist - Cleaning seeds.

TEACHING ACTIVITIES:

1. Show examples of seeds that have been cleaned.
2. Show examples of fruits containing seeds.
3. Outline procedures used to remove the seeds from dry fruit cones and fleshy fruit. (* 1,2,3 & 4)
4. Present lecture on drying seeds and testing the moisture content of seeds. (* 1,2,3 & 4)
5. Demonstrate how to remove the seeds from a dry fruit other than cones.
6. Show examples of cones that are and are not open.
7. Demonstrate how to remove the seeds from cones.
8. Question students on the effect on seeds of overexposure to high temperatures. (* 1,2,3 & 4)
9. Demonstrate how to remove the seeds from fleshy fruit.
10. Demonstrate how to dry the seeds.
11. Assign students to test the moisture content of seeds.
12. Demonstrate how to remove the remaining chaff and empty seed.
13. Assign each student a list of fruits for which to clean the seeds. (* 5)

CRITERION-REFERENCED MEASURE:

The student must separate the seeds from the fruit, dry the seeds and remove any remaining chaff and empty seed. The seeds must be dry (8%-15% moisture content) free of chaff or other parts of the fruit (less than 2% of weight is other than seed). The seeds must be without visible damage to the seed coat and contain viable embryos (within 2% of the germination rate of similar seeds cleaned by the test administrator).

PERFORMANCE GUIDE:

1. Separate seeds from the fruit:
   CAUTION: Seeds must not be damaged during extraction process. Follow extraction recommendations for particular plant species.
   A. Seeds in dry fruit other than cones:
      1. Spread dry fruit out on screens, cloth, or shelves in well ventilated area.
      2. Air-dry fruit for approximately one to three weeks.
      3. Thresh seeds.

PERFORMANCE GUIDE: (cont.)

    B. Seeds from cones:
        1. Open the cones:
            a. Air-dry cones for two to twelve weeks until the scales are open and seeds are exposed.
            b. Force-dry at 46°-60° C (115°-140° F) in a kiln for two hours to two days until seeds are open and seeds are exposed.
               CAUTION: Overexposure to high temperatures can damage seeds.
        2. Shake cones by tumbling or raking to remove seeds.
        3. Dewing the seeds from most species of cone-bearing plants.
    C. Seeds in fleshy fruit:
        1. Remove fleshy fruit from seeds soon after collection.
        2. Wash seeds to remove remaining pulp.
2. Dry seeds until their moisture content ranges from 8 to 15 percent.
3. Remove the remaining chaff and empty seed from the rest of the seed lot:
    A. Separate filled seed from chaff and empty seed by gravity.
    B. Separate filled seed from chaff and empty seed by pneumatic separators.

CHECKLIST

DUTY Harvesting Plants

TASK Clean seeds.

ENABLER

1. Measure kiln temperature.
2. Estimate and or measure moisture content of seeds.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to clean seeds.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Separated seeds from the fruit.	______	______
2.	Spread dry fruit out on screens, cloth, or shelves in well ventilated area.	______	______
3.	Air-dried fruit.	______	______
4.	Air-dried cones until the scales were open and seeds were exposed.	______	______
5.	Force-dried at 46°-60° C (115°-140° F) in a kiln until seeds were exposed.	______	______
6.	Shook cones by tumbling or raking to remove seeds.	______	______
7.	Detached (dewing) the seeds from cone-bearing plants.	______	______
8.	Removed fleshy fruit from seeds.	______	______
9.	Washed seeds to remove pulp.	______	______
10.	Dried seeds until their moisture content ranged from 8 to 15 percent.	______	______
11.	Removed the remaining chaff and empty seed from the rest of the seed lot.	______	______

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 143

TASK: Package seeds.

STANDARD OF PERFORMANCE OF TASK:

The sealed seed package must contain the predetermined amount of seeds and be labeled by species, cultivar, germination percentage, harvest date, and amount of seeds in package.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Seeds
Label
Scales
Package

ENABLING OBJECTIVES:

1. Write or print seed package information.
2. Recall units of measure for weight.
3. Count seeds.

***RESOURCES:**

1. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
2. Harness, & D'Angelo. (1987). The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.
3. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
4. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
5. Seed package label.
6. Checklist - Packaging seeds.

TEACHING ACTIVITIES:

1. Show examples of packaged seeds.
2. Show examples of a seed package label. (* 5)
3. Present lecture on seed package label information. (* 1,2,3,4 & 5)
4. Show examples of seeds that are packaged by weight.
5. Show examples of seeds that are packaged by seed count.
6. Demonstrate how to weigh and/or count seeds.
7. Demonstrate how to place the seeds in the seed package.
8. Demonstrate how to seal the seed package.
9. Question students on what information is included on the seed package label. (* 1,2,3,4 & 5)
10. Assign students to label the seed package.
11. Monitor students while they practice packaging seeds.
12. Assign each student a list of seeds to package. (* 6)

CRITERION-REFERENCED MEASURE:

The student must weigh and/or count the seeds, place the seeds in the seed package, seal the seed package and label the seed package. The sealed seed package must contain the predetermined amount of seeds and be labeled by species, cultivar, germination percentage, harvest date, and amount of seeds in package.

PERFORMANCE GUIDE:

1. Identify the amount of seeds to place in package:
    A. Count out predetermined number of seeds.
    B. Weigh out predetermined amount of seeds.
2. Place seeds in seed package.
3. Seal the seed package.
4. Label seed package:
    A. Species name.
    B. Cultivar or variety name.
    C. Weight or number of seeds.
    D. Germination percentage.
    E. Harvest date.

CHECKLIST

DUTY Harvesting Plants

TASK Package seeds.

ENABLER

1. Write or print seed package information.
2. Recall units of measure for weight.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to package seeds.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Counted predetermined number of seeds.		
2. Weighed out predetermined amount of seeds.		
3. Placed seeds in seed package.		
4. Sealed the seed package.		
5. Labeled seed package:		
- Species name.		
- Cultivar or variety name.		
- Weight or number of seeds.		
- Germination percentage.		
- Harvest date.		

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 144

TASK: Store seeds.

STANDARD OF PERFORMANCE OF TASK:

Specified type of seed must be stored using the recommended method of storage for particular plant species, seed viability, and length of storage.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Plant Propagation Principles and Practices.

CONDITIONS FOR PERFORMANCE OF TASK:

Seeds
Cold storage area
Warm storage area
Cold moist storage area
Moisture-retaining media
Moisture proof containers

ENABLING OBJECTIVES:

1. Look up recommended method of seed storage.
2. Measure storage temperature.
3. Estimate or measure relative humidity.
4. Evaluate moisture content of media.

***RESOURCES:**

1. Young, J., & Young, C. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.
2. Harness, & D'Angelo. (1987). The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.
3. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.
4. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.

***RESOURCES:** (cont.)

5. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.
6. Seed catalog.
7. Seed package label.
8. Checklist - Storing seeds.

TEACHING ACTIVITIES:

1. Show examples of seeds that do and do not store well.
2. List storage methods available. (* 1,2,3,4 & 5)
3. Present lecture on environmental factors that effect seed viability during storage. (* 1,2,3,4 & 5)
4. Present lecture on advantages and disadvantages of open storage, warm storage, cold storage and cold moist storage. (* 1,2,3,4 & 5)
5. Show examples of reference material used to determine the recommended method of storage for a particular plant species. (* 1,2,3,4,5,6 & 7)
6. Assign each student a plant species for which to determine the recommended method of storage.
7. Show examples of seed storage areas.
8. Show examples of containers and moisture-retaining media used to store seeds.
9. Demonstrate how to seal moisture-proof containers.
10. Demonstrate how to store the seeds along with moisture-retaining media.
11. Demonstrate how to measure the temperature in the storage area.
12. Demonstrate how to measure and/or estimate the relative humidity in the storage area.
13. Assign each student a list of seeds to store. (* 8)

CRITERION-REFERENCED MEASURE:

The student must determine and list the recommended method of seed storage, and store the seeds according to the listed method. Temperatures in the storage area must not deviate from the storage recommendations (plus or minus 5° F) and seeds must retain the moisture level (weight is the same plus or minus 2% after storage).

PERFORMANCE GUIDE:

1. Check references for recommended method of seed storage for particular plant species.
2. Identify storage conditions necessary for seed of particular plant species:
    A. Open storage:
    CAUTION: Relative humidity and temperature will affect the length of time the seed will remain viable.
        1. Use for temporary storage, generally less than one year.
        2. Use for seed that have water-impervious seed coats.

    B. Warm storage with humidity control:
        1. Use for temporary storage, generally less than one year.
        2. Use for many species of herbaceous plants.

    C. Cold storage:
        1. Use for most seed that will be held for longer than one year.
        2. Enhance the seed viability of seed stored in open storage or warm storage with humidity control.

    D. Cold moist storage:
        1. Use for seed for species which lose viability if dried.
        2. Use for some species of trees.
3. Place seeds in storage area:
    A. Dried seed:
        1. Seed which can be stored in open storage:
            a. Place seed in normally dry and cool location.
            b. Place seed in cold storage for increased longevity.
        2. Seed which can be stored under warm storage conditions with humidity control:
            a. Place seed in humidity controlled storage room or moisture resistant containers.
            b. Place seed in cold storage for increased longevity.
        3. Seed which should be stored in cold storage:
            a. Place seed at temperature ranging from 35°-40° F.
            b. Place seed that will be stored for long periods or seed that will deteriorate quickly, at freezing or below freezing.

PERFORMANCE GUIDE: (cont.)

B. Seed that have not been dried:
    1. Seed that require cold moist storage:
        a. Store at 32°-50° F.
        b. Place seed in containers that will maintain the high moisture content of the seed or in moisture-retaining media.

CHECKLIST

DUTY Harvesting Plants

TASK Store seeds.

ENABLER

1. Look up recommended method of seed storage.
2. Measure storage temperature.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to store seeds.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Listed the recommended method of seed storage for particular plant species.		
2. Listed storage conditions necessary for seed of particular plant species.		
3. Placed seeds in suitable container.		
4. Placed containers of seeds in area that can maintain required temperature and humidity.		
5. Checked temperature of storage area.		
6. Checked moisture level of seeds.		

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 145

TASK: Collect plant materials.

STANDARD OF PERFORMANCE OF TASK:

The required plant material must be identified, collected, and transferred to designated area without damage to plant material.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Cart
Plant material
Order for plant material

ENABLING OBJECTIVES:

1. Read plant materials order.
2. Read label.
3. Lift, carry and lower a plant.

***RESOURCES:**

1. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
2. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
5. Order for plant materials.
6. Checklist - Collecting plant materials.

TEACHING ACTIVITIES:

1. Show an example of an order for plant materials. (* 5)
2. Question students on the terms used to describe plant materials (B & B, 18-inch).
3. Assign students to locate plants listed on order.

TEACHING ACTIVITIES: (cont.)

4. Demonstrate how to lift, carry and lower plants.
5. Show examples of plants that are and are not uniformly sized.
6. Show examples of plants that should be culled.
7. Present lecture on the criteria used to cull plants. (* 1,2,3 & 4)
8. Discuss the importance of culling plants and/or collecting uniform plants.
9. Demonstrate how to tie, stake and/or sleeve plants. (* 1,2,3 & 4)
10. Question students on temporary storage requirements of plants.
11. Assign each student a list of plant material to collect. (* 6)

CRITERION-REFERENCED MEASURE:

The student must collect the listed plant material, cull undesirable plants, and transfer the plant materials to the designated area. All listed plant materials must be collected, all undesirable plants must be separated, temporary storage requirements of the collected plants must be provided and plant materials must not be damaged.

PERFORMANCE GUIDE:

1. Check order to determine plant materials that need to be collected.
2. Identify needed plant materials in growing area by:
    - A. Species.
    - B. Cultivar or variety.
    - C. Size of plant.
    - D. Size of container.
3. Identify method of collecting plant materials:
    - A. Block collection: Plant material from entire block will be collected before moving to another block of plants of the same species, cultivar and size.
        1. Gather required plant material in sequence from the block of plants.
        2. Cull any unsaleable plants.
    - B. Individual plant collection:
        1. Select individual plant material of the required species, cultivar, and size.
        2. Select uniform plant material for order from any block of plants.

PERFORMANCE GUIDE: (cont.)

4. Transfer plant material to designated grading, storage, or shipping area.
   NOTE: Plant material must be handled carefully to prevent any damage or breakage. Plants may need to be tied, staked or sleeved depending on individual species and condition.

CHECKLIST

DUTY Harvesting Plants

TASK Collect plant materials.

ENABLER

1. Read plant materials order.
2. Read label.
3. Lift, carry and lower a plant.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to collect plant materials.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Identified needed plant materials in growing area.		
2. Gathered required plant material in sequence from the block of plants.		
3. Culled any unsaleable plants.		
4. Selected individual plant material of the required species, cultivar, and size.		
5. Selected uniform plant material for order from any block of plants.		
6. Transferred plant material to designated grading, storage, or shipping area.		
7. Avoided damage to plants while handling.		

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 146

TASK: Store plant materials.

STANDARD OF PERFORMANCE OF TASK:

Conditioned plant material must be organized according to predetermined method, labeled, and stored at recommended environmental conditions for particular plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Carts
Labels
Storage area
Plant material

ENABLING OBJECTIVES:

1. Look up environmental conditions required for storage of plant materials.
2. Lift, carry and lower a plant.
3. Label plant materials.
4. Read thermometer.
5. Recall environmental requirements of living and or cut plant materials.

***RESOURCES:**

1. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
2. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
3. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.
4. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
5. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.
6. Checklist - Storing plant materials.

TEACHING ACTIVITIES:

1. Show examples of plant material with special storage requirements.
2. List plant materials with special storage requirements. (* 1,2,3,4 & 5)
3. List storage requirements for the listed plant materials. (* 1,2,3,4 & 5)
4. List resources available to help determine storage requirements of plant materials. (* 1,2,3,4 & 5)
5. Question students on the affect of spacing during storage on quality of plant materials.
6. Question students on what they would look for when checking the storage environment.
7. Show examples of plants that have deteriorated.
8. Assign each student a block and/or bundle of plant materials to store. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the name and type of plant materials, the environmental conditions required for storage, place the plants in the storage area, label the plants and provide the environmental conditions required. The listed environmental conditions must be the same as is recommended by the resources materials, the labels must be complete and legible and the storage conditions must maintain the quality of the plant materials.

PERFORMANCE GUIDE:

1. Identify particular species of plant material to be stored.
2. Estimate approximate length of storage for plant material.
3. Identify the optimum environmental conditions needed for particular plant species during the estimated storage period:
    A. Temperature requirements.
    B. Moisture requirements.
    C. Light intensity.
    D. Air movement.
    E. Humidity.
4. Place plant material in storage area using predetermined systematic method:
    A. Group plant material by species and by size.
    B. Group plant material by species, size, and date placed in storage.
    C. Group species by the date they are placed in storage.

PERFORMANCE GUIDE: (cont.)

5. Place plant material at optimum spacing for storage conditions.
6. Label plant material by species, size, and date placed in storage.
7. Inspect plant material periodically to insure quality is not deteriorating.
8. Check storage area periodically to insure optimum environmental conditions are maintained.
9. Check storage area periodically for air pollutants such as ethylene gas.

CHECKLIST

DUTY Harvesting Plants

TASK Store plant materials.

ENABLER

1. Look up environmental conditions required for storage of plant materials.
2. Lift, carry and lower a plant.
3. Label plant materials.
4. Read thermometer.
5. Recall environmental requirements of living and/or cut plant materials.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to store plant material.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed particular species of plant material to be stored.	______	______
2. Listed the estimated approximate length of storage for plant material.	______	______
3. Listed the optimum environmental conditions needed for particular plant species during the estimated storage period:		
- Temperature requirements.	______	______
- Moisture requirements.	______	______
- Light intensity.	______	______
- Air movement.	______	______
- Humidity.	______	______
4. Grouped plant material by species and by size.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
5. Grouped plant material by species, size, and date placed in storage.		
6. Grouped species by the date they are placed in storage.		
7. Placed plant material at optimum spacing for storage conditions.		
8. Labeled plant material by species, size, and date placed in storage.		
9. Inspected plant material periodically.		
10. Checked storage area periodically.		

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 147

TASK: Dig bareroot trees and shrubs.

STANDARD OF PERFORMANCE OF TASK:

A large percentage of the root system, all roots within a radial distance of 5 inches for each inch in trunk diameter and within a depth of 2 to 3 feet, must be dug and left intact with tree or shrub. The plant must be dug during the dormant season and must not be allowed to dry out during the digging process.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Wagon
U-blade
Spade
Tractor
Shovel
Spading fork
Trees or shrubs
Agitating lifter

ENABLING OBJECTIVES:

1. Recall recommended season for digging bareroot trees and shrubs.
2. Estimate/measure distance (inches/feet).
3. Evaluate soil moisture content.
4. Recall mechanical digging equipment safety.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Whitcomb, C. (1987). Landscape plant production. Stillwater, OK: Lacebark Publishing,
3. Mechanical digging equipment operating instructions.
4. Checklist - Digging bareroot trees and shrubs.

TEACHING ACTIVITIES:

1. Show examples of bare root trees and or shrubs.
2. Present lecture on calculating the length of the roots to dig.
3. Question students on the season of the year to dig bare root trees and shrubs. (* 1 & 2)
4. Assign students to check the moisture level of the soil.
5. Demonstrate how to dig bare root trees and/or shrubs manually.
6. Demonstrate how to operate tractor and/or other digging equipment. (* 3)
7. Discuss the importance of moving the bare root trees and/or shrubs to a shaded location.
8. Discuss the importance of protecting the plants roots from drying.
9. Discuss the importance of avoiding damage to roots during handling.
10. Present lecture on methods used to protect roots from drying.
11. Question students on manual digging methods.
12. Question students on mechanical digging methods. (* 3)
13. Question students on mechanical digging equipment safety. (* 3)
14. Monitor students as they practice digging bareroot trees and or shrubs.
15. Assign each student a block of trees and/or shrubs to dig bare root. (* 4)

CRITERION-REFERENCED MEASURE:

The student must check the soil moisture content, dig the tree or shrub manually or using mechanical digging equipment, move the bare root tree or shrub to a shaded location and protect the plant's roots from drying. The tree or shrub must be removed from the soil with all roots within a radial distance of 5 inches for each inch in truck diameter and to a depth of 2 to 3 feet left intact, without large amount of soil attached to the roots (no soil clumps larger than 2 inches in length or width), and without dry roots (roots remain turgid).

PERFORMANCE GUIDE:

1. Identify if it is a recommended season for digging bareroot trees and shrubs.
   NOTE: Deciduous trees and shrubs should be dug when no foliage is present during the dormant season. Digging operations should be completed early enough in the spring that plants will not bud out during shipping.
2. Select trees and shrubs to be dug by the bareroot method.
   NOTE: Generally, dormant trees and shrubs can be dug bareroot.
3. Check soil conditions to make sure moisture level is suitable for digging.
4. Select method of digging to be used:
   CAUTION: Dig and leave enough roots intact to support the plant at its new location.
   A. Manual:
      1. Dig trench around tree or shrub, at a radial distance of approximately 5 inches for each inch in trunk diameter.
      2. Loosen tree or shrub by digging under the plant's root system, approximately 2-3 feet deep.
      3. Cut through small roots when necessary.
      4. Comb through the loose soil with a spading fork.
      5. Lift bare roots out of ground with spade, shovel, or spading fork.
   B. Mechanical:
      1. Use U-blade and high clearance tractor or other mechanical digger to dig bareroot trees and shrubs.
      2. Follow manufacturer's recommendations and safety precautions.
5. Transfer bareroot trees and shrubs out of the sun.
6. Protect plant's roots from drying.

CHECKLIST

DUTY Harvesting Plants

TASK Dig bareroot tress and shrubs.

ENABLER

1. Recall recommended season for digging bareroot trees and shrubs.
2. Estimate/measure distance (inches/feet).
3. Evaluate soil moisture content.
4. Recall mechanical digging equipment safety.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to dig bareroot trees and shrubs.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Identified the recommended season for digging bareroot trees and shrubs.		
2.	Checked soil conditions to make sure moisture level was suitable for digging.		
3.	Dug trench around tree or shrub, at a radial distance of approximately 5 inches for each inch in trunk diameter.		
4.	Loosened tree or shrub by digging under the plant's root system, approximately 2-3 feet deep.		
5.	Combed through the loose soil with a spading fork.		
6.	Lifted bare roots out of ground with spade, shovel, or spading fork.		
7.	Used U-blade and high clearance tractor or other mechanical digger to dig bareroot trees and shrubs.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
8.	Followed manufacturer's recommendations and safety precautions.	________	________
9.	Transferred bareroot trees and shrubs out of the sun.	________	________
10.	Protected plant's roots from drying.	________	________

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 148

TASK: Ball trees and shrubs.

STANDARD OF PERFORMANCE OF TASK:

A tree's soil ball must measure 9 inches in diameter for each inch in trunk diameter. A shrub's soil ball must be proportionate with size of shrub and contain a sufficient amount of root system to support the plant at its new location. The soil ball must be firm and the plants' roots must not be allowed to dry out. The burlap must cover all roots, the entire soil ball, and must be tightly secured.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Spade
Nails
Twine
Burlap
Wire basket
Digging "pan"
Mechanical tree digger
Trees/shrubs growing in the field.

ENABLING OBJECTIVES:

1. Estimate/measure distance (inches/feet).
2. Evaluate soil moisture content.
3. Tie knots.
4. Recall mechanical digging equipment safety.

***RESOURCES:**

1. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
2. Ingels, J. (1987). Landscaping: Principles and practices (3rd ed.). Albany, NY: Delmar Publishers Inc.

***RESOURCES:** (cont.)

3. Mechanical digging equipment owner's manual.
4. Checklist - Digging ball and burlapped trees and shrubs.

TEACHING ACTIVITIES:

1. Show examples of ball and burlapped trees and/or shrubs.
2. Show examples of tools and materials used to ball and burlap plants.
3. Present lecture on calculating the size of the root ball required. (* 1 & 2)
4. Present lecture on the size and shape of the ball for fibrous and tap roots. (* 1 & 2)
5. Assign students to check the moisture level of the soil.
6. Demonstrate how to attach twine to the trunk or branches using a knot that does not girdle the trunk or branch.
7. Demonstrate how to dig a trench around the tree or shrub.
8. Demonstrate how to shape the soil ball.
9. Demonstrate how to undercut the soil ball.
10. Demonstrate how to dig the tree or shrub using mechanical digging equipment. (* 3)
11. Demonstrate how to wrap the ball with burlap and twine while inside or outside of the hole.
12. Demonstrate how to lift and carry a balled and burlapped tree or shrub.
13. Discuss the importance of keeping the ball intact and protecting the ball from drying out.
14. Question students on manual digging methods.
15. Question students on mechanical digging methods. (* 3)
16. Question students on mechanical digging equipment safety. (* 3)
17. Monitor students as they practice ball and burlapping trees and shrubs.
18. Assign each student a block of trees and/or shrubs to ball and burlap. (* 4)

CRITERION-REFERENCED MEASURE:

The student must check the soil moisture content, dig the ball manually or using mechanical digging equipment, wrap the ball with burlap and twine, lift and carry the balled and burlapped plant and protect the plant's roots from drying. The soil

CRITERION-REFERENCED MEASURE: (cont.)

ball for trees must measure 9 inches in diameter for each inch of truck diameter and the soil ball for shrubs must be proportionate with the size of the shrub. All soil balls must be firm, all roots must be covered with burlap and tightly secured with twine.

PERFORMANCE GUIDE:

1. Select tree/shrub to be dug.
2. Determine how large a soil ball is needed to support the tree/shrub:
    - A. Determine if tree/shrub has a taproot system.
    - B. Determine if tree/shrub has a fibrous root system.
3. Tie lower branches up with twine to reduce chances of damaging the branches.
4. Dig tree/shrub:
    - A. Dig the tree/shrub by hand:
        1. Dig a one foot deep trench at the optimum circumference of tree/shrub.
           NOTE: The trench should be dug with the back side of the spade always facing the tree/shrub, so the root ball is firmed as the trench is dug.
        2. Check to see if soil ball contains enough of the root system to support tree/shrub at its new location.
        3. Continue digging trench until optimum depth of soil ball is reached.
        4. Shape the soil ball to its final size.
        5. Undercut soil ball from the earth.
           CAUTION: Be careful not to break the soil ball.
        6. Slide a sheet of burlap in the trench and under the soil ball.
        7. Lift tree/shrub from hole while grasping the burlap or leave the plant in the hole for burlapping.
           CAUTION: Do not lift plant by its trunk.
    - B. Dig the tree/shrub mechanically:
        1. Determine optimum size of soil ball considering particular plant species, type of root system, and size of tree/shrub.
        2. Dig tree/shrub mechanically while following manufacturer's instructions.

PERFORMANCE GUIDE: (cont.)

3. Place a sheet of burlap under the soil ball.
   NOTE: Wire baskets may be used to secure soil ball instead of burlap, twine, and nails.
5. Wrap burlap tightly around the soil ball.
   CAUTION: Do not allow soil ball to dry out. Secure burlap immediately after tree/shrub is dug.
6. Pin burlap with nails as soil ball is being wrapped.
7. Gather burlap around trunk of shrub/tree.
8. Secure burlap around the soil ball with twine and tie it off around the trunk of the shrub/tree.
9. Move ball and burlap plant to protected storage area.

CHECKLIST

DUTY Harvesting Plants

TASK Ball trees and shrubs.

ENABLER

1. Estimate/measure distance (inches/feet).
2 Evaluate soil moisture content.
3. Tie knots.
4. Recall mechanical digging equipment safety.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to ball trees and shrubs.

PERFORMANCE DETERMINANTS	YES	NO
1. Identified how large a soil ball is needed to support the tree/shrub.	____	____
2. Identified the type of root system.	____	____
3. Tied lower branches up with twine.	____	____
4. Dug a one foot deep trench at the optimum circumference of tree/shrub.	____	____
5. Checked to see if soil ball contained enough of the root system to support tree/shrub at its new location.	____	____
6. Continued digging trench until optimum depth of soil ball was reached.	____	____
7. Shaped the soil balls.	____	____
8. Undercut soil ball from the earth.	____	____
9. Slid a sheet of burlap in the trench and under the soil ball.	____	____
10. Lifted tree/shrub from hole or wrapped plant in the hole.	____	____

PERFORMANCE DETERMINANTS (cont.)	YES	NO
11. Dug tree/shrub mechanically following manufacturer's instructions.	_______	_______
12. Moved plant to protected storage area.	_______	_______

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 149

TASK: Bundle plant materials.

STANDARD OF PERFORMANCE OF TASK:

The graded plant material must be bundled in uniform bundles with the predetermined number or weight according to "American Standards of Nursery Stock" for particular plant species in each bundle. The bundles must be secured and labeled with species name and date.

SOURCE OF STANDARD:

Writing team of incumbent workers.
American Standard of Nursery Stock.

CONDITIONS FOR PERFORMANCE OF TASK:

Wire
Label
Pencil
String
Graded plant material
American Standard of Nursery Stock

ENABLING OBJECTIVES:

1. Count and/or weigh plant materials.
2. Write or print information on label.

***RESOURCES:**

1. American Association of Nursurymen. (1980). American standard for nursery stock. Washington, DC: Author.
2. Checklist - Bundling plant material.

TEACHING ACTIVITIES:

1. List plant materials that are bundled.
2. List the number or weight of items included in a bundle for the listed plant materials. (* 1)
3. Question students on the possible results of incorrectly bundled plant materials.

TEACHING ACTIVITIES: (cont.)

4. Show examples of materials used to bundle plants.
5. Demonstrate how to bundle plant materials.
6. Show examples of bundles that are secured or not secured.
7. Demonstrate how to label the bundles.
8. Monitor students as they practice bundling plant materials.
9. Assign each student a list of plant materials to bundle. (* 2)

CRITERION-REFERENCED MEASURE:

The student must count or weigh the plant materials, secure the bundles and label the bundles. The bundles must contain the assigned number or weight, remain secure during handling, and the label must be complete and legible.

PERFORMANCE GUIDE:

1. Select graded plant material to be bundled.
2. Identify number or weight of plant material to be included per bundle for particular plant species according to the American Standard of Nursery Stock.
3. Place plant material of the same grade in the same bundle.
4. Secure the bundle.
5. Label and date bundles.

CHECKLIST

DUTY Harvesting Plants

TASK Bundle plant materials.

ENABLER

1. Count and/or weigh plant materials.
2. Write or print information on label.

STUDENT'S NAME ________________ **DATE** ________

EVALUATOR'S NAME ________________ **COURSE** ________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to bundle plant materials.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Identified graded plant material to be bundled.		
2.	Identified number or weight of plant material to be included per bundle.		
3.	Counted or weighed plant materials.		
4.	Placed plant material of the same grade in the same bundle.		
5.	Secured the bundle.		
6.	Labeled and dated bundles.		

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 150

TASK: Prepare plant materials for shipment.

STANDARD OF PERFORMANCE OF TASK:

Small plant material must be packed with packing material in a labeled crate or carton according to recommendations for particular plant species. Plant material too large for crates or cartons must be protected from damage and labeled.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Labels
Stakes
Plant material
Wooden splints
Crates or cartons
Packing material

ENABLING OBJECTIVES:

1. Look up the plant's stage of development recommended for shipping.
2. Evaluate moisture content of media.
3. Recognize dry/wet foliage.
4. Measure temperature.
5. Write or print information on label and shipping label.

***RESOURCES:**

1. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.
2. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.

***RESOURCES:** (cont.)

3. Sullivan, Robertson, & Staby. (1980). Management for retail florists with applications. Fort Worth, TX: Branch-Smith Publishing
4. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
5. Checklist - Preparing plant materials for shipment.

TEACHING ACTIVITIES:

1. Question students on the possible reaction of a customer if the plants they received were damaged due to improper packaging.
2. List plant materials that require preparation prior to shipment. (* 1,2,3 & 4)
3. Present lecture on the stage of plant development during which the listed plant materials are shipped. (* 1,2,3 & 4)
4. Present lecture on the packaging methods recommended for the listed plant materials. (* 1,2,3 & 4)
5. Discuss the importance of removing any damaged or diseased foliage or branches.
6. Question students on the problems associated with packaging plant materials with moisture on the foliage.
7. Discuss the importance of providing adequate moisture to the soil/media.
8. Discuss the importance of packaging cut plant materials only after it has been conditioned.
9. Question students on how to determine if cut plant material has been conditioned.
10. Discuss the importance of labeling the packaged plant materials.
11. Show examples of packaging materials.
12. Question students on the packaging methods for specific plant materials.
13. Monitor students as they practice packaging plant materials.
14. Assign each student a list of plant materials to package. (* 5)

CRITERION-REFERENCED MEASURE:

The student must list the recommended packaging method, inspect the plant material, package the plant material and label packaged plant material. The listed packaging method must be the same as

CRITERION-REFERENCED MEASURE: (cont.)

is recommended in the resource material, any damaged or diseased foliage or branches must be removed, soil/media must be moist but not dripping water, cut plant material must have been conditioned prior to packaging, foliage must be free of moisture, plant material must be protected from heat, cold and rough handling (test administrator's judgment) and all labels must be complete and legible.

PERFORMANCE GUIDE:

1. Identify plant material to be prepared for shipment.
   CAUTION: Package plant materials as close to shipment time as feasible.
2. Inspect plant material:
   - A. Check to insure plant material is at a recommended stage of development for shipping.
   - B. Remove any damaged or diseased foliage or branches.
   - C. Check foliage to insure no moisture is present.
3. Identify plant material by method plant material was harvested:
   - A. Live plants:
     1. Bareroot:
        - a. Place moist moisture-retaining media in a moisture-protective package.
        - b. Place bundled plants in moisture-retaining media.
     2. Container grown:
        - a. Check plants' media for moisture content.
        - b. Irrigate if needed and allow plants to drain before packaging.
          CAUTION: Foliage must be dry when packaged.
     3. Balled and burlapped:
        - a. Inspect soil ball for moisture.
        - b. Water soil ball if needed to prevent plant from drying during shipment:
          1. Allow soil ball to drain before shipping.
          2. Allow foliage to dry before shipping.

PERFORMANCE GUIDE: (cont.)

- 4. Unrooted cuttings:
  - a. Place moist moisture-retaining media in moisture-protective package.
  - b. Place bundled plants in moisture retaining media.
- B. Cut plant material:
  - 1. Inspect plant material to insure it has been conditioned and cooled to optimum temperature.
  - 2. Precool cartons and crates before packing.

4. Identify method plant material will be protected and packaged:
   - A. Plant material small enough to be packed in crates or cartons:
     - 1. Determine the number of bundles to be packed in each carton or crate.
     - 2. Select type of protective packing material to be used.
     - 3. Place labeled bundles of plant material in carton or crate.

       CAUTION: Precool cartons or crates, if plant material will be shipped under refrigeration.
     - 4. Protect plant material from damage by adding recommended packing material.
     - 5. Close and secure carton or crate.
     - 6. Label box:
       - a. Identify top of box.
       - b. Specify contents of box.
       - c. Specify temperature requirements of plant material.
     - 7. Attach shipping label:
       - a. Write customer's address on crate or carton.
       - b. Write return address on crate or carton.
       - c. Indicate shipping method.
   - B. Plant material too large to be packed in crates or cartons:
     - 1. Protect plant material from damage:
       - a. Sleeve plants.
       - b. Tie up branches on plants.
       - c. Protect plants with wooden splint.
     - 2. Label plant material:
       - a. Species.
       - b. Shipping date.
       - c. Customers name and address.
       - d. Catalog number.

CHECKLIST

DUTY Harvesting Plants

TASK Prepare plant materials for shipment.

ENABLER

1. Look up the plants stage of development recommended for shipping.
2. Evaluate soil/media moisture content.
3. Recognize dry/wet foliage.
4. Measure temperature.
5. Write or print information on label and shipping label.

STUDENT'S NAME________________________ **DATE**__________

EVALUATOR'S NAME______________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare plant materials for shipment.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Identified plant material to be prepared for shipment.	______	______
2. Checked to insure plant material is at a recommended stage of development for shipping.	______	______
3. Removed any damaged or diseased foliage or branches.	______	______
4. Checked foliage to insure no moisture was present.	______	______
Bare-root:		
5. Placed moist moisture-retaining media in a moisture-protective package.	______	______
6. Placed bundled plants in moisture-retaining media.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Container grown:		
7. Checked plants' media for moisture content.	______	______
8. Irrigated if needed and allow plants to drain before packaging.	______	______
Balled and burlapped:		
9. Inspected soil ball for moisture.	______	______
10. Watered soil ball if needed to prevent plant from drying during shipment.	______	______
11. Allowed soil ball to drain before shipping.	______	______
12. Allowed foliage to dry before shipping.	______	______
Unrooted cuttings:		
13. Placed moist moisture-retaining media in moisture-protective package.	______	______
14. Placed bundled plants in moisture retaining media.	______	______
Cut plant material:		
15. Inspected plant material to insure it has been conditioned and cooled to optimum temperature.	______	______
16. Precooled cartons and crates before packing.	______	______
17. Recorded method plant material will be protected and packaged.	______	______
18. Listed the number of bundles to be packed in each carton or crate.	______	______
19. Selected type of protective packing material to be used.	______	______
20. Placed labeled bundles of plant material in carton or crate.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Plant material small enough to be packed in crates or cartons:		
21. Protected plant material from damage by adding recommended packing material.	________	________
22. Closed and secure carton or crate.	________	________
23. Labeled box:		
- Identified top of box.	________	________
- Specified contents of box.	________	________
- Specified temperature requirements of plant material.	________	________
24. Attached shipping label:		
- Wrote customer's address on crate or carton.	________	________
- Wrote return address on crate or carton.	________	________
- Indicated shipping method.	________	________
Plant material too large to be packed in crates or cartons:		
25. Protected plant material from damage.	________	________
26. Labeled plant material:		
- Species.	________	________
- Shipping date.	________	________
- Customers name and address.	________	________
- Catalog number.	________	________

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 151

TASK: Grade plant materials.

STANDARD OF PERFORMANCE OF TASK:

Plant material must be graded by size, form, shape, foliage color, stock damage, and condition and number of flowers, according to "American Standard of Nursery Stock" for a particular plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.
American Standard of Nursery Stock.

CONDITIONS FOR PERFORMANCE OF TASK:

Tree grader
Plant materials
Measuring stick grader
American Standard of Nursery Stock

ENABLING OBJECTIVES:

1. Look up existing grades and grading criteria.
2. Measure distance (inches/feet).
3. Recall or look up characteristics of a plant species (foliage color, habit).
4. Distinguish between damaged and undamaged plants.

***RESOURCES:**

1. American Association of Nurserymen. (1980). American standard of nursery stock. Washinton, DC: Author.
2. Council of Tree and Landscape Appraisers. Guide for establishing values of trees and other plants. Chicago, IL: American Nurseryman Publishing Co.
3. American Nurseryman Publishing Co. Manual for plant appraisers [pamphlet]. Chicago, IL: Author.
4. Checklist - Grading plant materials.

TEACHING ACTIVITIES:

1. Show examples of plants that do and do not meet grading specifications.

TEACHING ACTIVITIES: (cont.)

2. Question students on which of the example plants they believe are more valuable.
3. Question students on what characteristics of the plants they evaluated when selecting the more valuable plant.
4. List the characteristics used to grade plants. (* 1,2 & 3)
5. Assign students to look up the grading specification for a type of plant material.
6. Question students on how to determine if a plant meets the size specifications. (* 1,2 & 3)
7. Present lecture on evaluation of foliage color and habit. (* 1,2 & 3)
8. List resources available to help determine the plants' normal foliage color and/or habit.
9. Question students on how to determine if a plant is damaged.
10. Discuss the importance of flowers when selling plant materials that are known for their flowers.
11. Present lecture on disposal and/or alternative marketing of plants not meeting grading specifications.
12. Monitor students as they practice grading plant materials.
13. Assign each student to a block of plants to grade. (* 4)

CRITERION-REFERENCED MEASURE:

The student must list the grading specifications for the assigned plant materials, record all measurements, list specific reasons why the plant was accepted or rejected on all listed grading specifications and separate the plants into uniform units. The listed grading specifications must be the same as the specification listed in the source, the recorded measurements must be accurate and legible, specific reasons for accepting or rejecting individual plant must be valid (test administrator's judgment) and the student must explain why the plants were sorted as they were.

PERFORMANCE GUIDE:

1. Identify existing grades for particular plant species using "American Standard of Nursery Stock".

PERFORMANCE GUIDE: (cont).

2. Measure plant material using "American Standard of Nursery Stock" standards:
    A. Determine height.
    B. Determine caliper of trunk.
    C. Determine number of branches or canes.
    D. Determine average spread of branches.
    E. Determine size of root ball:
        1. Measure depth.
        2. Measure height.
3. Examine plant material for form or shape.
4. Examine plant material for color of foliage.
5. Examine plant material for condition and number of flowers.
6. Examine plant material for disease, insect, animal, or mechanical damage.
7. Cull any plant material not meeting specified standards.
8. Sort plant material into uniform units according to plant size, form, color, flowers, and stock damage as specified by "American Standard of Nursery Stock".

CHECKLIST

DUTY Harvesting Plants

TASK Grade plant materials.

ENABLER

1. Look up existing grades and grading criteria.
2. Measure distance (inches/feet).
3. Recall or look up characteristics of a plant species (foliage color, habit).
4. Distinguish between damaged and undamaged plants.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to grade plant materials.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed existing grades for particular plant species.	______	______
2. Listed height.	______	______
3. Listed caliper of trunk.	______	______
4. Listed number of branches or canes.	______	______
5. Listed average spread of branches.	______	______
6. Listed size of root ball:		
- Measured depth.	______	______
- Measured height.	______	______
7. Examined plant material for form or shape.	______	______
8. Examined plant material for color of foliage.	______	______
9. Examined plant material for condition and number of flowers.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
10. Examined plant material for disease, insect, animal, or mechanical damage.	________	________
11. Culled any plant material not meeting specified standards.	________	________
12. Sorted plant material into uniform units.	________	________

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 152

TASK: Cut flowers.

STANDARD OF PERFORMANCE OF TASK:

Flowers must be harvested at the recommended stage of maturity for species. Flowers must be cut, placed in 100°F water with floral preservative, and held at 33°-40° F.

SOURCE OF STANDARD:

Writing team of incumbent workers.
1981 Cornell Recommendations For Commercial Floriculture Crops Part 1: Cultural Practices and Production Programs.

CONDITIONS FOR PERFORMANCE OF TASK:

Knife
Floral preservative
Bucket, non-metallic

ENABLING OBJECTIVES:

1. Look up harvesting recommendations for plant species.
2. Evaluate soil moisture content.
3. Irrigate plants.
4. Recall knife safety.
5. Measure temperature.

***RESOURCES:**

1. Cooperative Extension, Cornell University. (1981). Cornell recommendations for commercial floriculture crops part 1: Cultural practices and production programs. Ithaca, NY: Author.
2. Laurie, A., Kiplinger, D. & Nelson. (1979). Commercial flower forcing (8th ed.). Manchester, MO: McGraw-Hill Book Co.
3. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
4. Sperka, M. (1984). Growing wildflowers. New York, NY: Charles Scribner's Sons.

***RESOURCES:** (cont.)

5. Sullivan, Robertson, & Staby. (1980). Management for retail florists with applications. Fort Worth, TX: Branch-Smith Publishing
6. Checklist - Cutting flowers.

TEACHING ACTIVITIES:

1. Show examples of flowers (cut or intact) at various stages of maturity.
2. Question students on their prediction of the longevity of flowers harvested as tight buds, open flowers and at petal drop.
3. List references available to help determine the optimum stage of maturity during which to harvest flowers. (* 1,2,3,4 & 5)
4. Assign students to look up the harvesting recommendations for a plant species.
5. Present lecture on the advantages of irrigating plants prior to harvesting flowers.
6. Present lecture on the advantages of harvesting flowers when the carbohydrate levels in the plant are at their highest.
7. Present lecture on the time of day when carbohydrate levels are highest.
8. Present lecture on of cutting stems on an angle when harvesting flowers.
9. Present lecture on problems associated with woody stems and treatments for woody stems.
10. Present lecture on floral preservative treatment (ingredients, temperature).
11. Present lecture on storage conditions for cut flowers.
12. Monitor students as they practice selecting flowers at the recommended stage of maturity.
13. Question students on knife safety.
14. Assign each student a plant(s) from which to cut flowers. (* 6)

CRITERION-REFERENCED MEASURE:

The student must list the recommendations for harvesting the flowers of the assigned plant, irrigate the plants if needed, harvest the flowers, place the flowers in floral preservative and store the flowers. The listed harvesting recommendations must be the same as those listed in the reference material. The flowers must be removed from turgid

CRITERION-REFERENCED MEASURE: (cont.)

plants at an appropriate time of day (test administrator's judgment). The cut flower stem must be of appropriate length, and exhibit a smooth angled cut made at a point on the stem that has not become woody or otherwise prepared according to recommendations. The cut flowers must be placed in 100° F water containing floral preservative and stored at 33-40° F.

PERFORMANCE GUIDE:

1. Identify if flowers of particular species are at the recommended stage of maturity for harvesting.
   NOTE: Flowers should be harvested in the afternoon when carbohydrate levels are high in the plant. Since plants are more likely to be suffering from moisture stress in the afternoon, they must be irrigated early in the day, if needed.
2. Cut stems at an angle near the base of the stem, but above the woody part of the stem, with a sharp knife.
3. Place cut flowers in 100°F water with floral preservative immediately.
4. Place flowers at 35°-40°F as soon as possible after cutting.

CHECKLIST

DUTY Harvesting Plants

TASK Cut flowers.

ENABLER

1. Look up harvesting recommendations for plant species.
2. Evaluate soil moisture content.
3. Irrigate plants.
4. Recall knife safety.
5. Measure temperature.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to cut flowers.

PERFORMANCE DETERMINANTS	YES	NO
1. Cut stems at an angle near the base of the stem, but above the woody part of the stem, with a sharp knife.	____	____
2. Placed cut flowers in 100°F water with floral preservative immediately.	____	____
3. Placed flowers at 35°-40°F as soon as possible after cutting.	____	____

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 153

TASK: Cut sod.

STANDARD OF PERFORMANCE OF TASK:

A layer of sod with soil depth of .3-1 inch must be cut and removed mechanically from moist soil. Manufacturer's recommendations and safety precautions must be followed. The sod must be cut to specified length, rolled, and moved to storage area.

SOURCE OF STANDARD:

Writing team of incumbent workers.
Turfgrass Science and Management.

CONDITIONS FOR PERFORMANCE OF TASK:

Pallets
Wagon/cart
Sod cutter
Sod harvester
Sod harvest site

ENABLING OBJECTIVES:

1. Recognize strong dense sod.
2. Evaluate soil moisture content.
3. Irrigate turf.
4. Measure sod length, width and thickness.
5. Lift, carry and lower a roll of sod.
6. Recall general equipment safety.

***RESOURCES:**

1. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar Publishers, Inc.
2. Beard, J. (1972). Turfgrass: Science and culture. Fort Worth, TX: Branch-Smith Publishing.
3. Daniel, W., & Freeborg, R. (1980). Turf managers' handbook. Cleveland, OH: Harvest.
4. Sprague, H. (1982). Turf management handbook. Danville, IL: The Interstate Printers and Publishers, Inc.
5. Turgeon, A. (1980). Turf grass management. Reston, VA: Reston.

***RESOURCES:** (cont.)

6. Sod cutter or sod harvester operating instructions.
7. Checklist - Cutting sod.

TEACHING ACTIVITIES:

1. Present lecture on the thickness of the soil removed with the sod. (* 1,2,3,4 & 5)
2. Present lecture on the width and length of a roll of sod. (* 1,2,3,4 & 5)
3. Present lecture on handling and storage of sod. (* 1,2,3,4 & 5)
4. Show examples of sod that was cut too thin and/or sod that was cut too thick.
5. Show examples of sod fields that are ready for harvest and/or sod fields that are not ready for harvest.
6. Assign students to check the moisture content of the soil.
7. Assign students to irrigate the area to be harvested if the soil surface is dry.
8. Present lecture on sod cutter and/or sod harvester safety. (* 6)
9. Demonstrate how to start the sod cutter or sod harvester. (* 6)
10. Demonstrate how to adjust the sod cutter or sod harvester.
11. Demonstrate how to cut a length of sod. (* 6)
12. Assign students to measure the length, width and thickness of the cut sod.
13. Assign students to lift the sod vertically by the end of its length.
14. Question students on whether or not the sod holds together.
15. Demonstrate how to readjust the sod cutter or sod harvester if needed. (* 6)
16. Demonstrate how to roll or fold the sod. (* 1,2,3,4 & 5)
17. Demonstrate how to lift, carry, lower and stack the folded sod. (* 1,2,3,4 & 5)
18. Question students on sod cutter and/or sod harvester safety. (* 6)
19. Monitor students as they practice cutting sod.
20. Assign students to store the sod. (* 1,2,3,4 & 5)
21. Assign each student an area of sod to cut. (* 7)

CRITERION-REFERENCED MEASURE:

The student must start, adjust and operate the sod cutter or sod harvester, check the length, width and thickness of the cut sod, readjust the sod

CRITERION-REFERENCED MEASURE: (cont.)

cutter or sod harvester if needed, roll or fold the sod, stack the sod and store the sod. The sod must have a soil depth of .3 - 1 inch, uniform width and length (does not vary by greater than 1"), be rolled tightly, stacked with every other layer being perpendicular to the previous layer and stored in a cool shady location.

PERFORMANCE GUIDE:

1. Identify if sod is ready for harvest.
   CAUTION: Sod must be strong and dense enough to stay intact when harvested.
2. Irrigate area to be harvested if surface soil moisture is dry.
3. Operate sod cutter or sod harvester according to manufacturer's recommendations and safety precautions:
   A. Remove a thin-cut layer of sod, generally with a soil depth of .3-1 inch.
   B. Calculate sod length:
      1. Cut to a length of 4-6 feet if sod will be installed by hand.
      2. Cut to specified length when sod will be installed from a bar on the back of a tractor.
   C. Roll or fold the sod.
   D. Stack the sod.
4. Move rolls of sod to cool, shady storage area.

CHECKLIST

DUTY Harvesting Plants

TASK Cut sod.

ENABLER

1. Recognize strong dense sod.
2. Evaluate soil moisture content.
3. Irrigate turf.
4. Measure sod length, width and thickness.
5. Lift, carry and lower a roll of sod.
6. Recall general equipment safety.

STUDENT'S NAME______________________ **DATE**__________

EVALUATOR'S NAME______________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to cut sod.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Indicated if sod was ready for harvest.		
2.	Irrigated area to be harvested if needed.		
3.	Operated sod cutter or sod harvester according to manufacturer's recommendations and safety precautions.		
4.	Removed a layer of sod with a soil depth of .3-1 inch.		
5.	Cut sod to specified length.		
6.	Rolled or folded the sod.		
7.	Stacked the sod.		
8.	Moved rolls of sod to cool, shady storage area.		

DUTY: HARVESTING PLANTS

PERFORMANCE OBJECTIVE NO. 154

TASK: Condition plant materials.

STANDARD OF PERFORMANCE OF TASK:

Live plants must be acclimatized following recommendations for particular plant species. Plants must be treated with antitranspirant or fungicide if recommended. Cut plant material must be recut, placed in 100°F solution of floral preservative, and placed at recommended temperature.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Knife
Fungicide
Live plants
Antitranspirant
Cut plant material
Floral preservative
Non-metallic buckets

ENABLING OBJECTIVES:

1. Recall environmental conditions required for plant survival.
2. Recall horticultural chemical safety.
3. Recall knife safety.
4. Recall plant nutrient names.
5. Measure temperature.
6. Measure/estimate light intensity.
7. Measure/estimate relative humidity.
8. Evaluate soil moisture content.
9. Distinguish between turgid and wilted plant material.

***RESOURCES:**

1. Laurie, A., Kiplinger, D. & Nelson. (1979). Commercial flower forcing (8th ed.). Manchester, MO: McGraw-Hill Book Co.

*RESOURCES: (cont.)

2. Cooperative Extension, Cornell University. (1981). Cornell recommendations for commercial floriculture crops part 1: Cultural practices and production programs. Ithaca, NY: Author.
3. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.
4. Graham. (1987). Growing succulent plants. Portland, OR: Timber Press.
5. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.
6. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers and Publishers, Inc.
7. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers and Publishers, Inc.
8. Hirsch, D. (1977). Indoor plants comprehensive care and culture. Radnor, PA: Chilton.
9. Briggs, G., & Calvin, C. (1986). Indoor plants. Chicago, IL: American Nurseryman Publishing Co.
10. Furuta, T. (1983). Interior landscaping. Fort Worth, TX: Branch-Smith Publishing.
11. Checklist - Conditioning plants.

TEACHING ACTIVITIES:

1. List plants and/or plant materials that requires conditioning prior to sale and/or transplanting.
2. Outline procedures used to condition the listed plants.
3. Question students on the possible results if plants were incompletely conditioned.
4. Show examples of plants and/or plant materials that were and were not conditioned.
5. List the specific environmental conditions that are regulated as part of the conditioning process and their effect on the plant. (* 4,5,6,7,8,9 & 10)
6. List references available to help determine procedures for conditioning plants and/or plant materials. (* 1,2,3,4,5,6,7,8,9 & 10)
7. Demonstrate how to condition cut plant material. (* 1 & 2)
8. Question students on horticultural chemical safety.
9. Question students on knife safety.
10. Assign each student a block of plants and/or bundle of plant materials to condition. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the recommended conditioning treatments, and perform the recommended conditioning treatments. Live plants must be acclimatized following recommendations for particular plant species. Plants must be treated with antitranspirant or fungicide if recommended. Cut plant material must be recut, placed in 100°F solution of floral preservative, and placed at recommended temperature.

PERFORMANCE GUIDE:

1. Identify conditioning treatment method required:
   A. Identify particular plant species.
   B. Identify plant materials by method or form plant material was harvested.
   C. Identify stage of maturity plant material was harvested.
2. Perform treatment:
   A. Live plants:
      1. Acclimatize plants:
         a. Adjust nutrient levels.
         b. Regulate light intensity levels.
         c. Adjust temperature levels.
         d. Regulate moisture levels.
      2. Spray plants with antitranspirant if recommended for particular plant species.
      3. Apply fungicide if recommended for particular plant species.
         NOTE: Roots of bareroot plants are often treated with a fungicide.
   B. Cut plant material:
      1. Recut stems at an angle.
         NOTE: Remove 1/2-1 inch from the base of stem.
      2. Remove bottom 3-4 inches of foliage from stem.
      3. Place in 100°F floral preservative solution.
         NOTE: Type and concentration of floral preservatives depend on particular plant species and stage of maturity at harvest.
      4. Place plant material at recommended temperature, generally 33°-40°F, for particular plant species and stage of maturity at harvest.

CHECKLIST

DUTY Harvesting Plants

TASK Condition plant materials.

ENABLER

1. Recall environmental conditions required for plant survival.
2. Recall horticultural chemical safety.
3. Recall knife safety.
4. Recall plant nutrient names.
5. Measure temperature.
6. Measure/estimate light intensity.
7. Measure/estimate relative humidity.
8. Evaluate soil moisture content.
9. Distinguish between turgid and wilted plant material.

STUDENT'S NAME__________ **DATE**__________

EVALUATOR'S NAME__________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to condition plant materials.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Listed conditioning treatment method required.	______	______
Live plants:		
2. Adjusted nutrient levels.	______	______
3. Regulated light intensity levels.	______	______
4. Adjusted temperature levels.	______	______
5. Regulated moisture levels.	______	______
6. Sprayed plants with antitranspirant.	______	______
7. Applied fungicide.	______	______

PERFORMANCE DETERMINANTS (cont.)	YES	NO
Cut plant material:		
8. Recut stems at an angle.	________	________
9. Removed bottom 3-4 inches of foliage from stem.	________	________
10. Placed stems in 100°F floral preservative solution.	________	________
11. Placed plant material at recommended temperature.	________	________

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 155

TASK: Plan advertising program.

STANDARD OF PERFORMANCE OF TASK:

Advertising promotions must be scheduled objectives of the campaign and reach the desired population. Budget restraints, advertising costs, and effectiveness must be used when selecting media form.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Advertising budget
Cost estimates of media forms

ENABLING OBJECTIVES:

1. Recall purposes of advertising.
2. Recall descriptors for and/or categories of customer populations.
3. Recall how to find out the characteristics of the population.
4. Recall how to find out the advantages and disadvantages of a variety of media forms.
5. Recall how to find out the time frames that are available for advertisers.

***RESOURCES:**

1. American Nurseryman Publishing Co. Direct mail advertising summary [pamphlet]. Chicago, IL: Author.
2. American Nurseryman Publishing Co. Guide to effective advertising [pamphlet]. Chicago, IL: Author.
3. American Nurseryman Publishing Co. Newspaper advertising summary [pamphlet]. Chicago, IL: Author.
4. American Nurseryman Publishing Co. (1977). Operating an effective advertising program. Chicago, IL: Author.

***RESOURCES:** (cont.)

5. American Nurseryman Publishing Co. Partners for profit advertising manual. Chicago, IL: Author.
6. American Nurseryman Publishing Co. Radio advertising summary. Chicago, IL: Author.
7. Checklist - Planning an advertising program.

TEACHING ACTIVITIES:

1. Discuss the importance of a planned advertising program.
2. Present lecture on how to determine the customer population that the advertising program is attempting to reach.
3. List the products and services offered by a horticultural business.
4. List other needs of a horticultural business that advertising could help fulfill.
5. Compile the lists of a horticultural business' needs.
6. Present lecture on timing of advertisements in relation to the needs of the horticultural business.
7. Demonstrate scheduling of advertising promotions based on the list of the horticultural business' needs.
8. Present lecture on what is included in a specific objective for a particular advertising promotions.
9. Assign students to write specific objectives for particular advertising promotions.
10. Present lecture on the characteristics of customer populations.
11. Present lecture on the advantages and disadvantages of types of media forms. (* 1,2,3,4,5 & 6)
12. Question students on what media forms are suitable for different types of populations.
13. Present lecture on the possible ways that the annual advertising budget can be determined.
14. Present lecture on advertising rates for promotional packages.
15. Question students on media selection.
16. Question students on duties for seasonal promotions.
17. Question students on time of day for advertising.
18. Demonstrate the selection of a media form, and the time frame (if applicable) for a given business' need, population and budget.
19. Monitor students as they practice selecting media forms for a variety of situations.
20. Assign each student to plan an advertising program. (* 7)

CRITERION-REFERENCED MEASURE:

The student must describe the potential customer population, list the advertising needs of the horticultural business, schedule the advertising promotions, write specific objectives for each scheduled promotion and select the media form(s) and time frame(s) (if applicable) for each advertising promotion.

PERFORMANCE GUIDE:

1. Identify the customer population that the advertising program is attempting to reach.
2. Schedule advertising promotions according to the specified needs of the horticultural business.
3. Obtain the annual advertising budget figures.
4. Identify specific objectives for particular advertising promotions.
5. Identify the media forms most suitable for designated population:
    A. Sign.
    B. Radio.
    C. Television.
    D. Newspaper.
    E. Professional journal.
    F. Telephone book.
6. Select forms of media to use when advertising, consider:
    A. Budget restraints.
    B. Cost of media forms.
    C. Effectiveness of each media form.
7. Schedule advertising promotions during the time frame that will reach the largest percentage of designated population.

CHECKLIST

DUTY Performing Sales

TASK Plan advertising program.

ENABLER

1. Recall descriptors for and/or categories of customer populations.
2. Recall how to find out the characteristics of the population.
3. Recall how to find out the advantages and disadvantages of a variety of media forms.
4. Recall how to find out the time frames that are available for advertisers.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to plan an advertising program.

PERFORMANCE DETERMINANTS	YES	NO
1. Described the potential customer population.	______	______
2. Listed the advertising needs of the horticultural business.	______	______
3. Selected dates for the advertising promotions.	______	______
4. Wrote specific objectives for each scheduled promotion.	______	______
5. Selected the media form(s) for each advertising promotion.	______	______
6. Selected the time frame(s) (if applicable) for each advertising promotion.	______	______

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 156

TASK: Conduct public relations activities.

STANDARD OF PERFORMANCE OF TASK:

Selected public relation activities must be performed and fulfill the company's objectives for the selected activity.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Typewriter
Tape recorder
Plant material
Display materials
Customer mailing list

ENABLING OBJECTIVES:

1. Evaluate the public's perception of a horticultural business.
2. Recall public relation activities.
3. Compose bulletins, new articles and/or advertisements.
4. Display horticultural products.

***RESOURCES:**

1. Sullivan, Robertson, & Staby. (1980). Management for retail florists with applications. Fort Worth, TX: Branch-Smith Publishing.
2. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
3. Checklist - Conducting public relations activities.

TEACHING ACTIVITIES:

1. Question students on the value of public relations.
2. Question students on the specific public relations activities in which they have participated.
3. Present lecture on types of public relations activities.

TEACHING ACTIVITIES:

4. List horticultural businesses.
5. Question students on the populations served by the listed horticulture businesses. (* 1 & 2)
6. Present lecture (topic selection) based on the needs of the horticultural businesses.
7. Present lecture on the scheduling of public relations activities.
8. List activities for the listed horticultural businesses.
9. Present lecture on a hypothetical or real horticultural business and the publics to be reached by the activities.
10. Question students on activities that could be used to reach the publics of the hypothetical or real business.
11. Assign each student a public relation activity to conduct. (* 3)

CRITERION-REFERENCED MEASURE:

The student must list the population to be reached by the public relations activity, list the possible activities, schedule activities, and perform the activities. Selected public relation activities must be performed and fulfill the company's objectives for the selected activity.

PERFORMANCE GUIDE:

1. Identify the objective of the public relations activities.
2. Select type of public relations activities most beneficial for particular business operations.
3. Choose a specific topic for activity:
    A. New plant varieties or cultivars.
    B. New horticultural products.
    C. Tips and answers to commonly asked questions.
    D. Preventative maintenance.
    E. General information.
    F. Price changes.
4. Perform selected activities:
    A. Informational bulletins, brochures, and/or newsletters.
    B. Informational displays.
    C. Informational radio and/or television announcements or shows.
    D. Informational newspaper articles or columns.
    E. Special classes.
    F. Community goodwill activities.

CHECKLIST

DUTY Performing Sales

TASK Conduct public relations activities.

ENABLER

1. Evaluate the public's perception of a horticultural business.
2. Recall public relation activities.
3. Compose bulletins, new articles and/or advertisements.
4. Display horticultural products.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**__________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to conduct public relations activities.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Listed the population to be reached.		
2.	Listed public relations activities beneficial for the particular business operations.		
3.	Chose an activity.		
4.	Performed selected activities.		

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 157

TASK: Present sales information to customer.

STANDARD OF PERFORMANCE OF TASK:

Plant material and/or product cost, functions, application, growth habits, care requirements and/or comparisons must be included in sales information given to interested customer. All customer questions must be answered.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Customer
Products
Plant materials
Product information
Plant material information

ENABLING OBJECTIVES:

1. Listen to customer's questions.
2. Use resources to answer customer's questions.

***RESOURCES:**

1. Sullivan, Robertson, & Staby. (1980). Management for retail florists with applications. Fort Worth, TX: Branch-Smith Publishing.
2. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
3. Checklist - Presenting sales information to customers.

TEACHING ACTIVITIES:

1. Question students on the importance of sales to a horticultural business.
2. List horticultural businesses.
3. List products sold by the listed horticultural businesses. (* 1 & 2)

TEACHING ACTIVITIES: (cont.)

4. List customers (wholesale/retail, commercial/homeowner) of the horticultural businesses.
5. Question students on information that customer may request.
6. Question students on resources available to help answer customer questions. (* 1 & 2)
7. Assign a student to play the role of a salesperson and another student to play the role of a customer seeking information.
8. Assign each student a list of horticultural products for which to present the sales information. (* 3)

CRITERION-REFERENCED MEASURE:

The student must greet the customer (test administrator), provide any information the customer requests and answer the customer's questions. Plant material and/or product cost, functions, application, growth habits, care requirements and/or comparisons must be included in sales information given to the customer. All customer questions must be answered.

PERFORMANCE GUIDE:

1. Greet the customer.
2. Offer to help the customer.
3. Identify the products or plant materials to which the customer is showing interest.
4. Explain pertinent information:
    A. Horticultural products:
        1. Cost of product.
        2. Functions of product.
        3. Applications of product.
        4. Comparison of similar products.
    B. Plant materials:
        1. Cost of plant materials.
        2. Plant materials' growth habits.
        3. Plant materials' care requirements.
        4. Comparison of similar plant materials.
5. Answer the customer's questions.
6. Ask if customer would like to purchase the selected products and/or plant materials.

CHECKLIST

DUTY Performing Sales

TASK Present sales information to customer.

ENABLER

1. Listen to customer's questions.
2. Use resources to answer customer's questions.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to present sales information to customer.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Greeted the customer (test administrator).		
2. Offered to help the customer.		
3. Explained pertinent information to the customer.		
4. Answered the customer's questions.		
5. Asked if the customer would like to purchase the selected products and/or plant materials.		

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 158

TASK: Prepare sales invoice.

STANDARD OF PERFORMANCE OF TASK:

Sales invoice must include customer information, salesperson's signature, type of sale, method of shipping, purchase information and cost.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Order
Price list
Sales invoice

ENABLING OBJECTIVES:

1. Communicate with the customer.
2. Print, write or type with enough pressure to obtain an image on all copies.
3. Determine price and inventory/catalog number of an unmarked item.
4. Recall types of sales.
5. Use calculator to add, subtract, multiply and divide.
6. Determine if item is taxable.
7. Determine if plant royalties should be changed.
8. Recall methods of shipping that are available.

***RESOURCES**

1. Garden Center of America. (1983). Garden center business forms. Chicago, IL: American Nurseryman Publishing Co.
2. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
3. Sullivan, Robertson, & Staby. (1980). Management for retail florists with applications. Fort Worth, TX: Branch-Smith Publishing
4. Checklist - Preparing a sales invoice.

TEACHING ACTIVITIES:

1. Discuss the importance of accuracy when preparing a sales invoice. (* 1)
2. Show several examples of sales invoices. (* 1)
3. Present lecture on parts of a sales invoices. (* 1)
4. Demonstrate completion of the customer information section of a sales invoice.
5. Demonstrate completion of the purchase information section of a sales invoice.
6. Present lecture on how to indicate the type of sale and method of shipping. (* 2 & 3)
7. Question students on how to total the sales invoice.
8. Present lecture on why customers must sign for charges.
9. Present lecture on distribution of sales invoice copies.
10. Assign each student a sales invoice to prepare. (* 4)

CRITERION-REFERENCED MEASURE:

The student must ask the test administrator for and record the information concerning the customer, the type of sale and the method of shipping. The student must complete the information concerning the purchase, total the sales invoice, initial and date the sales invoice, get customer to sign the invoice (if necessary), and distribute the copies of the sales invoice. The sales invoice must be completed and total cost must equal the price of all items plus all taxes and all royalties

PERFORMANCE GUIDE:

1. Obtain a sales invoice.
2. Complete a sales invoice:
   A. Include information concerning the customer:
      1. Name and address.
      2. Phone number.
      3. Delivery instructions, if required.
   B. Include information concerning the purchase:
      1. Date.
      2. Quantity of items purchased.
      3. Name and description of items purchased.
      4. Inventory/catalog number of items purchased.
      5. Price of item purchased.
      6. Delivery date.

PERFORMANCE GUIDE: (cont.)

    C. Indicate type of sale:
        1. Cash sale.
        2. Layaway
        3. Company charge.
        4. Credit-card.
        5 . C.O.D.
    D. Indicate method of shipping:
        1. Parcel Post.
        2. Special delivery.
        3. Grower's truck.
    E. Total the sales invoice:
        1. Figure line item totals by multiplying cost of item by the quantity.
        2. Add all line items and record on sales invoice.
        3. Determine amount of sales tax on taxable items and record on sales ticket.
        4. Add delivery/shipping charge if applicable.
        5. Add plant royalty cost, if applicable.
        6. Add the total cost of items, sales tax, delivery charge, and royalty charge to final total cost.
    F. Sign or initial the sales invoice.
3. Distribute copies:
    A. Customer copy.
    B. Shipping copy.
    C. File copy.

CHECKLIST

DUTY Performing Sales

TASK Prepare sales invoice.

ENABLER

1. Communicate with the customer.
2. Write with enough pressure to obtain an image on all copies.
3. Recall types of sales.
4. Use calculator to add, subtract, multiply and divide.
5. Determine if item is taxable.
6. Determine if plant royalties should be changed.
7. Recall methods of shipping that are available.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to prepare a sales invoice.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Asked the test administrator for customer information.		
2.	Recorded the customer information.		
3.	Recorded the type of sale.		
4.	Recorded the method of shipping.		
5.	Recorded the items purchased.		
6.	Recorded the number of each item purchased.		
7.	Recorded price of each item.		
8.	Recorded applicable taxes.		
9.	Recorded applicable royalties.		
10.	Totaled the sales invoice.		

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
11.	Signed the sales invoice.		
12.	Distributed the copies of the sales invoice.		
13.	Thanked the customer.		

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 159

TASK: Deliver products to customer.

STANDARD OF PERFORMANCE OF TASK:

Horticultural products must be loaded and secured on truck in the reverse order of the order of scheduled stops. Products must be delivered to specified destination without damage to the plants. The customer's signature must be obtained on the delivery form.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Truck
Delivery schedule
Horticultural products

ENABLING OBJECTIVES:

1. Recall horticultural terminology for container sizes, types and other plant packaging methods.
2. Lift, carry and lower heavy items and/or use loading equipment.
3. Operate delivery vehicle.
4. Read a map.
5. Read delivery schedule.

***RESOURCES:**

1. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.
2. Pfahl, P. (1983). The retail florist business. Fort Worth, TX: Branch-Smith Publishing.
3. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
4. Delivery schedule.
5. Checklist - Loading horticultural products for delivery.

TEACHING ACTIVITIES:

1. Show an example of a delivery schedule. (* 4)
2. Present lecture on arranging products on the delivery vehicle in a reverse order for predetermined stops.
3. Present lecture on lifting and carrying heavy horticultural products.
4. Present lecture on load securing and protecting the horticulture products on the delivery vehicle.
5. Present lecture on protecting horticultural products from temperature extremes during shipment. (* 1,2 & 3)
6. Discuss the importance of safety when operating a delivery vehicle.
7. Discuss the importance of obtaining the customer's signature upon delivery.
8. Discuss the importance of thanking the customer.
9. Evaluate the students ability to lift and carry heavy horticultural products.
10. Assign each student a delivery schedule for which to load a delivery vehicle. (* 5)

CRITERION-REFERENCED MEASURE:

The student must load and secure the horticultural products, list the measures to be taken to protect the horticultural products and unload the horticultural products. And the customer must sign all horticultural products on the delivery schedule must be loaded and arranged in reverse order of the scheduled stops, secured to prevent shifting and unloaded without damage. The listed protective measure must be sufficient to preserve the quality of the horticultural products.

PERFORMANCE GUIDE:

1. Obtain delivery schedule.
2. Select horticultural products to be delivered.
3. Group horticultural products that will be delivered at the same predetermined stops.
4. Load horticultural products onto the truck:
   CAUTION: Horticultural products must be handled carefully to prevent damage during all stages of the delivery process.
   A. Place products that will be delivered last at the front of the truck.

PERFORMANCE GUIDE: (cont.)

B. Continue the loading sequence until the products that will be delivered first are loaded last.
C. Secure crates, cartons, and individual plants to prevent damage to plants.
NOTE: Plants that cannot be placed onto crates or cartons should be protected from wind while driving.

5. Study delivery schedule to insure customer's name and address and directions to delivery point are included on schedule.
6. Drive truck to the first delivery point.
7. Unload the customer's designated products from truck at the first delivery site.
8. Note any damaged products or return items.
9. Place horticultural products in a protected area, if possible.
10. Obtain signature of customer.
11. Thank the customer for his/her business.
12. Repeat steps 6-10 until all products have been delivered.

CHECKLIST

DUTY Performing Sales

TASK Deliver products to customer.

ENABLER

1. Recall horticultural terminology for container sizes, types and other plant packaging methods.
2. Lift, carry and lower heavy items and/or use loading equipment.
3. Operate delivery vehicle.
4. Read a map.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to deliver products to customers.

	PERFORMANCE DETERMINANTS	**YES**	**NO**
1.	Grouped horticultural products that will be delivered at the same predetermined stops.	________	________
2.	Handled horticultural products carefully.	________	________
3.	Placed products that will be delivered last at the front of the truck.	________	________
4.	Secured crates, cartons, and individual plants to prevent damage to plants.	________	________
5.	Protected plants from wind.	________	________
6.	Unloaded the horticultural products without damaging them.	________	________
7.	Unloaded products at correct locations.	________	________
8.	Noted any damaged products.	________	________
9.	Placed horticultural products in a protected area.	________	________

PERFORMANCE DETERMINANTS (cont.)	**YES**	**NO**
10. Obtained signature of customer.	________	________
11. Thanked the customer for their business.	________	________

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 160

TASK: Price horticultural products.

STANDARD OF PERFORMANCE OF TASK:

The selling price of the horticultural product must be calculated by using profit percentage, production costs, value, grade, demand, and shrinkage figures. The selling price must be recorded.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Label
Sticker
Calculator
Record book
Waterproof pen
Product's grade
Production costs
Horticultural product

ENABLING OBJECTIVES:

1. Use calculator to add, subtract, multiply and/or divide.
2. Write or print numbers or operate a price gun.
3. Read price lists, catalogs and invoices.

***RESOURCES:**

1. Council of Tree and Landscape Appraisers. Guide for establishing values of trees and other plants. Chicago, IL: American Nurseryman Publishing Co.
2. Kooi, C. (1985). Estimating and management principles for landscape contractors. Chicago, IL: American Nurseryman Publishing Co.
3. Pfahl, P. (1983). The retail florist business. Fort Worth, TX: Branch-Smith Publishing.
4. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.

***RESOURCES:** (cont.)

5. Garden Center of America. (1983). Garden center business forms. Chicago, IL: American Nurseryman Publishing Co.
6. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.
7. Horticultural business catalog or price list.
8. Checklist - Pricing horticultural products.

TEACHING ACTIVITIES:

1. Show examples of horticultural products.
2. Question students on the price the horticultural products.
3. Question students on ways that the prices for horticultural products can be determined.
4. Present lecture on the factors to consider when calculating the selling price for a horticultural product. (* 1,2,3 & 4)
5. Present lecture on shrinkage. (* 6)
6. Present a hypothetical situation in which one factor, such as demand, has a greater effect on the selling price than other factors.
7. Show an example of a price list. (* 5 & 7)
8. Demonstrate how to record the price on the price list. (* 5 & 7)
9. Show examples of materials used to mark prices.
10. Demonstrate how to mark prices on horticultural products.
11. Question students on the reason for using a water proof pen.
12. Question students on the type of surface to which a price sticker will adhere.
13. Discuss the importance of accuracy when calculating prices, recording prices and marking prices.
14. Assign each student a list of horticultural products to price. (* 8)

CRITERION-REFERENCED MEASURE:

The student must calculate and record the selling price of the horticultural product and mark the price on the horticultural product. The student must explain the factors considered when calculating price, all calculations must be accurate (plus or minus 1%) the recorded price must be legible and the price must be clearly marked on the horticultural product with a waterproof pen (test administrator's judgment).

PERFORMANCE GUIDE:

1. Select horticultural products to be priced.
2. Calculate the selling price of the horticultural products:
   - A. Figure the cost of production for the horticultural product.
   - B. Estimate the selling value.
   - C. Determine the product's grade.
   - D. Estimate the demand for product.
   - E. Estimate the shrinkage of product.
   - F. Determine required profit percentage.
3. Record price in record book, plant catalog, and/or price list.
4. Mark price on horticultural product:
   - A. Use waterproof pen to write the price on label, sticker, or container.

CHECKLIST

DUTY Performing Sales

TASK Price horticultural products.

ENABLER

1. Use calculator to add, subtract, multiply and/or divide.
2. Write or print numbers or operate a price gun.

STUDENT'S NAME______________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to price horticultural products.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Calculated the selling price of the horticultural products.	______	______
2.	Listed the cost of production for the horticultural product.	______	______
3.	Listed the estimated selling value.	______	______
4.	Listed the product's grade.	______	______
5.	Listed the estimated the demand for product.	______	______
6.	Listed the estimated shrinkage of product.	______	______
7.	Listed required profit percentage.	______	______
8.	Recorded price in record book, plant catalog, and/or price list.	______	______
9.	Marked price on horticultural product.	______	______
10.	Used waterproof pen to write the price.	______	______

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 161

TASK: Display retail products.

STANDARD OF PERFORMANCE OF TASK:

Retail product display areas must be clean, well-organized, and balanced. All prices on retail products must be marked.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Props
Price tags
Retail products

ENABLING OBJECTIVES:

1. Conceptualize an idea for a display.
2. Draw or sketch idea for display.
3. Evaluate displays for balance and effect.
4. Analysis customers' needs, preferences, and purchasing habits.

RESOURCES:

1. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.
2. Mortenson, W. (1977). Modern marketing of farm products. Danville, IL: The Interstate Printers and Publishers, Inc.
3. Manaker, G. (1987). Interior plantscapes. Fort Worth, TX: Branch-Smith Publishing.
4. Sunset Books. (1980). Decorating with plants. Menlo Park, CA: Lane Publishing Co.
5. Checklist - Displaying retail products.

TEACHING ACTIVITIES:

1. Show examples of attractive, well thought out, effective displays. (* 3 & 4)
2. Present lecture on using displays to educate the customers. (* 1 & 2)

TEACHING ACTIVITIES: (cont.)

3. Discuss the importance of display appearance in promoting sales.
4. List things that could make a display less attractive and/or less effective.
5. Present lecture on balance and effect.
6. List horticultural products that are/are not promoted through display methods.
7. Present lecture on displaying combinations of products for "tie-in-sales".
8. Present lectures on seasonal, holiday or special displays.
9. Present lecture on methods used to display retail products.
10. Present lectures on special display methods.
11. Question students on what display method they would use for a specific retail product.
12. Discuss the importance of display location.
13. List possible locations and the best location to display a specific retail product.
14. Present lecture on logical sequencing of retail products.
15. Present lecture on the use of props in displays.
16. Monitor students as they practice logically sequencing a group of retail products and props.
17. Present lecture on sketching the retail products and props in the display area.
18. Demonstrate the use of sketching materials.
19. Monitor students as they practice sketching the retail products and props in their selected location using the selected display method.
20. Discuss the importance of properly priced products.
21. Demonstrate how to place prices on retail products.
22. Assign each student to arrange the group of retail products and props according to their sketches. (* 5)

CRITERION-REFERENCED MEASURE:

The student must select a display method, select a display location, conceptionalize an idea, sketch the display, mark the prices of the products, and set up the display. The display method and location must be logical, the sketch must show all items used in the display, the price of all products must be unmistakable and the display must be clean, well-organized and balanced.

PERFORMANCE GUIDE:

1. Identify the method retail products will be displayed:
    A. Shelf, bench, or bed displays:
    B. Special displays:
2. Design display area:
    A. Shelf, bench, or bed displays:
        1. Select retail products that will be displayed.
        2. Sketch the area where products are to be displayed:
            a. Organize products in a logical sequence.
            b. Determine the location where specific products will be displayed.
        3. Obtain any needed props.
        4. Clean props and display area.
        5. Mark prices on retail products.
    B. Special displays:
        1. Select specific purpose of display:
            a. Promote holiday sales.
            b. Promote seasonal products.
            c. Educate how products are used.
            d. Promote sale items.
        2. Select a simple theme for display.
        3. Select products that will be included in the display.
        4. Sketch the proposed display.
        5. Select location for display.
        6. Clear the display area of any unwanted items.
        7. Clean the display area.
        8. Obtain any needed props that will be used to display the retail products.
3. Arrange retail products according to idea and sketched design.
    A. Make any adjustments to create proper balance and effect.
    B. Check retail products to ensure their prices are displayed.

CHECKLIST

DUTY Performing Sales

TASK Display retail products.

ENABLER

1. Conceptualize an idea for a display.
2. Draw a sketch for display.
3. Evaluate displays for balance and effect.

STUDENT'S NAME________________________________**DATE**__________

EVALUATOR'S NAME______________________________**COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to display retail products.

PERFORMANCE DETERMINANTS	**YES**	**NO**
1. Selected a logical display method.	______	______
2. Selected a logical display location.	______	______
3. Selected display items.	______	______
4. Sketched idea for display.	______	______
5. Communicated idea for display.	______	______
6. Marked the prices of the products so that the prices were unmistakable.	______	______
7. Set up a clean, well-organized and balanced display.	______	______

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 162

TASK: Deposit daily cash receipts.

STANDARD OF PERFORMANCE OF TASK:

A deposit slip must be completed and daily cash receipts must be totaled. The deposit must be made according to company's safety policy and a deposit receipt must be obtained and filed.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Money bag
Deposit slip
Batch header slip
"Deposit Only" stamp
Deposit amount (currency, coin, and checks)

ENABLING OBJECTIVES:

1. Recognized and count United States currency and coins.
2. Use calculator to add.
3. Print, write or type numbers.
4. Recall methods of customer payments.
5. File records according to system.
6. Read calendar.

RESOURCES:

1. Reproductions of checks.
2. Reproductions of credit card receipts.
3. Deposit slip.
4. Batch header slip.
5. Checklist - Depositing daily cash receipts.

TEACHING ACTIVITIES:

1. Question students on whether or not they have ever deposited cash and/or checks at a bank.
2. Question students on the possible reactions of an employer if money to be deposited was mishandled.

TEACHING ACTIVITIES: (cont.)

3. Show example of checks and credit card receipts. (* 1 & 2)
4. Present lecture on the purpose of stamping checks.
5. Show examples of deposit slip and batch header slips. (* 3 & 4)
6. Demonstrate how to complete a deposit slip and batch header slip. (* 3 & 4)
7. Discuss the importance of double checking your addition.
8. Question students on safety precautions for traveling to the bank.
9. Question students on how to make a deposit.
10. Discuss the importance of obtaining a deposit receipt.
11. Discuss the importance of filing the deposit receipt.
12. Assign each student a set of checks, credit card receipts and/or cash to deposit. (* 5)

CRITERION-REFERENCED MEASURE:

The student must total the amount of the checks, credit card receipts and cash, complete the deposit slip and batch header slip and list the safety precautions to take when traveling to the bank. The deposit slip (batch header slip, credit card receipts) must include the date and the total for the checks, the total for the cash and the amount of the deposit must be the same as the sum of the actual amounts.

PERFORMANCE GUIDE:

1. Total the amount of daily cash receipts in deposit:
   A. Add the currency.
   B. Add the coins.
   C. Add the checks.
   D. Add the credit card receipts.
2. Stamp back of checks with the business's "For Deposit Only" stamp.
3. Complete deposit slip and/or batch header:
   A. Record the date of deposit.
   B. Enter the amount of deposit.
   C. Enter the account to which the deposit will be credited.

PERFORMANCE GUIDE: (cont.)

4. Place deposit, deposit slip and/or batch header in a money bag.
5. Make the deposit:
   CAUTIONS: Follow the city's and the company's safety policy for traveling to the financial institution with deposit.
   A. Give money bag to the teller.
   B. Obtain a deposit receipt.
6. File receipt.

CHECKLIST

DUTY Performing Sales

TASK Deposit daily cash receipts.

ENABLER

1. Recognize and count United States currency and coins.
2. Use calculator to add.
3. Print, write or type numbers.
4. Recall methods of customer payments.
5. File records according to system.
6. Read calendar.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to deposit daily cash receipts.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Totalled the amount of daily cash receipts.		
	- Included the currency.	______	______
	- Included the coins.	______	______
	- Included the checks.	______	______
	- Included the credit card receipts.	______	______
2.	Stamped the back of the checks.	______	______
3.	Recorded the date of deposit.	______	______
4.	Recorded the amount of deposit.	______	______
5.	Recorded deposit to the account.	______	______
6.	Completed deposit slip.	______	______
7.	Completed batch header.	______	______

	PERFORMANCE DETERMINANTS (cont.)	YES	NO
8.	Completed deposit slip and batch header slip.		
9.	Listed safety considerations for transporting deposit.		
10.	Filed receipt.		

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 163

TASK: Complete daily sales reports.

STANDARD OF PERFORMANCE OF TASK:

The day's sales receipts, sales tax figures, and payments on account must be reconciled with the cash register tape and recorded. Each department's daily sales totals must be calculated and recorded.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Sales receipts
Cash register tape

ENABLING OBJECTIVES:

1. Use calculator to add, subtract, multiple and/or divide.
2. Print, write or type numbers.
3. Recall methods of customer payment.

RESOURCES:

1. Garden Center of America. (1983). Garden center business forms. Chicago, IL: American Nurseryman Publishing Co.
2. Sales receipts.
3. Cash register operating instructions.
4. Cash register tape.
5. Checklist - Completing daily sales reports.

TEACHING ACTIVITIES:

1. Question students on the value of sales figure records.
2. Show example of sales receipts indicating that payment was made by cash, check and/or credit card. (* 1 & 2)
3. Show examples of sales receipts that indicated that the purchase was charged to an account. (* 1 & 2)

TEACHING ACTIVITIES: (cont.)

4. Present lecture on recording the amount of cash purchases, credit card purchases and purchases charged to accounts.
5. Present lecture on recording payments made on accounts and sales tax figures.
6. Present lecture on totaling the cash register. (* 3 & 4)
7. Present lecture on reconciling the day's sales receipts with the cash register total.
8. List departments of a horticultural business.
9. Present lecture on reasons why sales records are kept for each department.
10. Assign each student a set of sales receipts and a cash register tape for which to complete a daily sales report. (* 5)

CRITERION-REFERENCED MEASURE:

The student must record the amount of cash purchases, amount of credit card purchases, amount of purchases charged to accounts, amount of payments made on accounts and sales tax figures, reconciled the days sales receipts with the cash register tape and list the amount of sales from each department. All recorded figures must be accurate and legible (test administrator's judgment).

PERFORMANCE GUIDE:

1. Count the day's sales receipts:
   A. Record cash purchases.
   B. Record company's charge purchases.
   C. Record credit card purchases.
2. Record the day's sales tax figures.
3. Record payments made on accounts.
4. Total the cash register tape.
5. Reconcile the day's sales receipts with the cash register tape.
6. Credit the sale of each item with the corresponding department.
7. Total each department's sales for the day.

CHECKLIST

DUTY Performing Sales

TASK Complete daily sales reports.

ENABLER

1. Use calculator to add, subtract, multiply and/or divide.
2. Print or type numbers.
3. Recall methods of customer payment.

STUDENT'S NAME____________________ **DATE**________

EVALUATOR'S NAME____________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to complete daily sales reports.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Recorded cash purchases.		
2.	Recorded company's charge purchases.		
3.	Recorded credit card purchases.		
4.	Recorded the day's sales tax figures.		
5.	Recorded payments made on accounts.		
6.	Added total daily receipts.		
7.	Totaled the cash register tape.		
8.	Reconciled the day's sales receipts with the cash register tape.		
9.	Credited the sale of each item with the corresponding department.		
10.	Totaled each department's sales for the day.		

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 164

TASK: Operate cash register.

STANDARD OF PERFORMANCE OF TASK:

Operational procedures must include the identification of purchase item and its department, the entering of purchase costs on machine, tax, and method of payment.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Coins
Checks
Currency
Receipts
Tax table
Credit cards
Cash register
Purchase items
Credit card machine
Company charge forms
Credit card sales slip
"For Deposit Only" stamp

ENABLING OBJECTIVES:

1. Read cash register operating instructions.
2. Identify horticultural products.
3. Recall methods of payment.
4. Recognize an invalid check.
5. Count money.

RESOURCES:

1. Garden Center of America. (1983). Garden center business forms. Chicago, IL: American Nurseryman Publishing Co.
2. Price list.
3. Horticultural product catalog.
4. Sales tax laws.

RESOURCES: (cont.)

5. Tax tables.
6. Sample checks.
7. Bad check list.
8. Credit card sales slip.
9. Company change forms.
10. Cash register operating instructions.
11. Checklist - Operating a cash register.

TEACHING ACTIVITIES:

1. Show examples of horticultural products.
2. Question students on the identity of a horticultural product (name, size & packaging).
3. Present lecture on looking up the cost of a horticultural product. (* 2 & 3)
4. Present lecture on taxable items and nontaxable items or services. (* 4)
5. Present lecture on use of tax tables. (* 5)
6. Question students on methods of payments.
7. Show examples of checks that are and are not filled out properly. (* 6)
8. Present lecture on verifying the check writer's identification and/or checking the bad check list. (* 7)
9. Present lecture on stamping the back of checks.
10. Present lecture on completion of the credit card sales slip and/or verification of the credit card account. (* 8)
11. Present lecture on completion of a company charge form and/or verification of the company charge account. (* 9)
12. Discuss the importance of accuracy and legibility when completing charge forms.
13. Demonstrate how to operate a cash register. (* 10)
14. Monitor students as they practice operating a cash register.
15. Monitor students as they practice completing credit card slips and company charge forms.
16. Assign each student a list of horticultural products to enter into a cash register, total and collect payment for the products. (* 11)

CRITERION-REFERENCED MEASURE:

The student must list the name, size and packaging of the horticultural products, separate taxable items from nontaxable items, enter the cost of the items, enter the amount of sales tax, total the

CRITERION-REFERENCED MEASURE: (cont.)

entries, complete a credit card slip and company charge form, and receive payment by check and cash. All entries into the cash register must be correct, all forms must be complete, and legible (test administrator's judgment), all checks received must be valid for the exact amount of purchase and stamped on the back, and cash received must be the exact amount of the purchase.

PERFORMANCE GUIDE:

1. Identify type of cash register that will be operated:
    - A. Mechanical.
    - B. Electronic.
    - C. Scanner.
2. Enter costs of purchases according to manufacturer's instructions for the operation of particular cash register:
    - A. Identify item being purchased.
    - B. Identify the department that receives credit for the sale.
    - C. Enter cost of purchases:
        - 1. Taxable items.
        - 2. Non-taxable items or services.
    - D. Enter tax.

      NOTE: Follow company's policy on procedure for errors and other operation policies.
3. Total the cost of purchases.
4. Collect payment from customer.
5. Indicate the method of payment from particular customer.
6. Collect payment:
    - A. Cash (currency and/or coin):
        - 1. Make change if necessary.
    - B. Check:
        - 1. Stamp back of check with company's "For Deposit Only" stamp.
        - 2. Follow company policy on check acceptance.
    - C. Credit card:
        - 1. Check expiration date on card.
        - 2. Follow credit card company's policy on credit card acceptance.
        - 3. Complete credit card sales form.

PERFORMANCE GUIDE: (cont.)

  - D. Company's charge:
    - 1. Follow company's policy on company charge acceptance.
    - 2. Follow company's procedure on completing company charge sales.
- 7. Give customer register tape receipt or other receipts.

CHECKLIST

DUTY Performing Sales

TASK Operate cash register.

ENABLER

1. Read cash register operating instructions.
2. Identify horticultural products.
3. Recall methods of payment.
4. Recognize an invalid check.
5. Count money.

STUDENT'S NAME________________________________ **DATE**__________

EVALUATOR'S NAME______________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to operate cash register.

	PERFORMANCE DETERMINANTS	YES	NO
1.	Identified items being purchased.		
2.	Identified the department that receives credit for the sale.		
3.	Separated taxable items from non-taxable items or services.		
4.	Entered cost of purchases.		
5.	Entered sales tax.		
6.	Totaled the cost of purchases.		
7.	Indicated the method of payment.		
8.	Collected cash payment.		
9.	Made change.		
10.	Stamped back of check.		
11.	Followed policy on check acceptance.		
12.	Checked expiration date on credit card.		

PERFORMANCE DETERMINANTS (cont.)	YES	NO
13. Followed policy on credit card acceptance.	________	________
14. Completed credit card sales form.	________	________
15. Followed policy on company charge acceptance.	________	________
16. Completed company charge sales.	________	________
17. Gave customer register tape receipt or other receipts.	________	________

DUTY: PERFORMING SALES

PERFORMANCE OBJECTIVE NO. 165

TASK: Estimate cost of customer's order.

STANDARD OF PERFORMANCE OF TASK:

Length of production, amount of labor required and cost of special treatment must be used to figure the estimated cost of ordered plant species.

SOURCE OF STANDARD:

Writing team of incumbent workers.

CONDITIONS FOR PERFORMANCE OF TASK:

Labor cost
Plant production cost
Plant production records

ENABLING OBJECTIVES:

1. Use calculator to add, subtract, multiply, and/or divide.
2. Estimate labor requirements.
3. Read production records.

RESOURCES:

1. Kooi, C. (1985). Estimating and management principles for landscape contractors. Chicago, IL: American Nurseryman Publishing Co.
2. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.
3. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.
4. Wholesale grower catalog.
5. Production records.
6. Horticultural supply catalog.
7. Checklist - Estimating production costs.

TEACHING ACTIVITIES:

1. List plants (name, size & packaging) that are produced by horticultural businesses. (* 4)
2. Evaluate the students knowledge of the market value of the listed plants.

TEACHING ACTIVITIES: (cont).

3. List resources available to help determine plant production costs. (* 1,2,3 & 5)
4. List the factors to consider in estimating the cost of producing the plants. (* 1,2 & 3)
5. Present lecture on determining the cost of materials needed to produce the plant. (* 6)
6. Present lecture on determining the amount of labor needed to produce the plant. (* 1,2,3 & 5)
7. Present lecture on determining the length of time needed to produce a saleable plant. (* 5)
8. Present lecture on determining overhead costs. (* 2 & 3)
9. Present lecture on profit margins, volume discounts and unpredictable costs. (* 2 & 3)
10. Assign each student a list of plants (name, size & packaging) for which to estimate production costs. (* 7)

CRITERION-REFERENCED MEASURE:

The student must list the cost of materials, labor, and overhead needed to produce the plant(s). The listed costs must be verifiable (students can explain rationale behind costs, including reference materials used).

PERFORMANCE GUIDE:

1. Review data on plant production cost.
2. Review data on labor cost.
3. Prepare an estimate:
   A. List number of requested plants of specified species.
   B. Determine length of time needed to produce saleable plant.
   C. Determine amount of labor needed to produce specified species.
   D. Determine cost of any special treatments required by specified species.
   E. Calculate the approximate cost per plant produced.
   F. Calculate total estimated cost of plants.
   G. Estimate cost of requested products and/or services.
   H. Compute total estimate.

CHECKLIST

DUTY Performing Sales

TASK Estimated cost of customer's order.

ENABLER

1. Use calculator to add, subtract, multiply, and/or divide.
2. Estimate labor requirements.
3. Read production records.

STUDENT'S NAME______________________________ **DATE**__________

EVALUATOR'S NAME____________________________ **COURSE**________

DIRECTIONS TO THE EVALUATOR:

Use the following checklist to evaluate a student's ability to estimate cost of customer's order.

PERFORMANCE DETERMINANTS	YES	NO
1. Listed number of requested plants.		
2. Listed length of time needed to produce saleable plant.		
3. Listed amount of labor.		
4. Listed cost of any special treatments.		
5. Listed the approximate cost per plant.		
6. Listed total estimated cost of plants.		
7. Recorded estimated cost of requested products and/or services.		

APPENDICES

APPENDIX A

TASK LIST AND JOB TITLES

Ornamental Horticulture Production Occupations
CIP Code: 02.0404

Specialty Grower
DOT:405.161-018

Plant Propagator
DOT:405.361-010

Horticultural Worker I
DOT:405.684-014

Horticultural Worker II
DOT:405.687-014

DUTIES:

- Tasks

DUTY A: PERFORMING ADMINISTRATIVE FUNCTIONS

Maintain horticultural supply and stock inventory
Maintain equipment inventory
Prepare equipment purchase orders
Prepare supply orders
Store stock and supplies
Plan plant stock production needs
Plan work orders
Determine daily assignments
Maintain payroll records
Prepare payroll checks
Maintain accounts receivable records
Maintain accounts payable records
Maintain fiscal balance sheet records
Employ business personnel
Train employees
Evaluate employee performance
Dismiss employees
Prepare state and federal reports
Maintain trade organization certification
Supervise employees
Maintain employee benefit records
Estimate labor requirements
Plan plant production schedules
Plan plant propagation schedules
Determine method of propagation

DUTY B: PREPARING SOIL AND GROWING MEDIA

Collect soil samples
Test soil sample
Pasteurize growing media
Sterilize media with chemical soil sterilant
Mix growing media
Alter pH of growing media
Prepare compost pile
Calculate fertilizer requirements
Incorporate fertilizer into growing media
Prepare mulch beds for storage of plant materials
Haul topsoil
Spread topsoil to establish a grade
Incorporate compost
Perform soil erosion control practices
Prepare seedbed
Aerate sod
Top dress lawn

DUTY C: PROPAGATING HORTICULTURAL PLANTS

Test seeds for germination percentage
Sow seeds
Stratify seeds
Scarify seeds
Prick off seedlings
Harden off seedlings
Transplant seedlings
Take cuttings
Stick cuttings in medium other than water or mist
Apply growth regulator to cuttings
Remove cuttings from the propagating area
Harden off cuttings
Propagate plants using approach grafting
Propagate plants using bark grafting
Propagate plants using bridge grafting
Propagate plants using cleft grafting
Propagate plants using inarch grafting
Propagate plants using side grafting
Propagate plants using splice grafting
Propagate plants using wedge grafting
Propagate plants using whip and tongue grafting
Propagate plants using T-budding
Propagate plants using chip budding
Propagate plants using air layering
Propagate plants using mound layering
Propagate plants using trench layering
Propagate plants using serpentine layering

DUTY C: PROPAGATING HORTICULTURAL PLANTS (cont.)

Propagate plants by division
Set time clocks for mist system
Identify spacing for species during propagation
Prepare tissue culture growing medium
Prepare explants for Stage I
Transfer shoot cultures
Lay sod

DUTY D: GROWING PLANTS

Irrigate field grown plants
Irrigate container grown plants
Prune plants
Shear plants
Pot plants
Transplant trees and shrubs
Lay barrier
Plant cover crops
Apply mulch to a planting bed
Label plants
Disbud plants
Stake plants
Pinch plants
Perform simple plant tissue test
Interpret simple plant tissue test
Calculate liquid fertilizer concentrations
Prepare fertilizer solution
Fertilize plants
Inspect crops for pests
Identify insects for insect control
Identify diseases for disease control
Identify weeds for weed control
Spray plants for pest control
Calculate pesticide concentrations
Drench plants for pest/environmental control
Fumigate plants for pest control
Apply granular pesticides
Control pests biologically
Control pests mechanically
Establish plant spacing
Regulate growing structure temperature
Regulate growing structure humidity
Control growing structure light intensity
Regulate plants photoperiod
Remove dead trees and shrubs
Treat plant wounds
Mow turf grass

DUTY D: GROWING PLANTS (cont.)

Roll sod
Renovate turf
Reseed worn spots on turf
Regulate carbon dioxide in a greenhouse
Apply growth regulator to crops
Plant bulbs, corms, tubers, and tuberous roots
Plant grass stolons, sprigs, and plugs

DUTY E: PERFORMING MAINTENANCE OPERATIONS

Prepare equipment for winter storage
Construct temporary growing structures
Construct planters and flats
Sharpen hand tools and blades
Perform preventive maintenance of equipment
Service engine oil and filters
Perform minor engine tune-up
Maintain irrigation systems
Glaze or recover greenhouse structures
Clean work area
Dispose of waste materials
Replace drive chains
Replace broken or stripped gears
Lubricate equipment
Service drive belts
Clean equipment
Maintain pesticide applicator
Maintain growing structure heating system
Maintain growing structure cooling system
Order repair parts for equipment

DUTY F: HARVESTING PLANTS

Collect seeds
Clean seeds
Package seeds
Store seeds
Collect plant materials
Store plant materials
Dig bareroot trees and shrubs
Ball trees and shrubs
Bundle plant materials
Prepare plant materials for shipment
Grade plant materials
Cut flowers
Cut sod
Condition plant materials

DUTY G: PERFORMING SALES

Plan advertising program
Conduct public relations activities
Present sales information to customer
Prepare sales invoice
Deliver products to customer
Price horticultural products
Display retail products
Deposit daily cash receipts
Complete daily sales reports
Operate cash register
Estimate cost of customers' order

APPENDIX B

DEFINITIONS OF TERMS

1. **AFFECTIVE**. Skills which emphasize an attitude, feeling, emotion, or degree of acceptance and rejection.
2. **ALIQUOT**. A small but representative and reproducible part of a solution, or sample.
3. **ASEPTIC**. Not septic (alive); free from septic (living) materials.
4. **CATALOG**. A comprehensive collection of performance objectives, performance guides, and related data developed in a specific domain.
5. **CHECKPOINT**. A point in the development of the curriculum guide when materials must be sent to V-TECS control office for quality review.
6. **CIP CODE**. A code developed by the U.S. Office of Education to identify a specific cluster of related jobs for training program identification.
7. **COGNITIVE**. Skills which emphasize the recall of knowledge and development of intellectual abilities.
8. **COMPETENCY**. The ability (including knowledge, skills, and/ or attitudes) to perform a specific task of duty successfully.
9. **COMPETENCY-BASED EDUCATION**. Educational program in which students are given specific requirements for individual performances which must be met in order to advance in instruction.
10. **COMPETENCY-BASED-VOCATIONAL EDUCATION**. A methodology of instruction that (a) identifies the competencies needed for on-the-job performance; (b) informs students and required to achieve these competencies; (c) emphasizes requirements, and/or graduation; and (d) facilitate learning by letting each student master the tasks prior to advancing to another.

11. **CONSORTIUM.** A group of state agencies, institutions, or other entities which have been legally constituted through letters of commitment, agreements, or by assignment of higher authorities to work together toward the solution of problems in education. A consortium, for the purposes of this work, must have membership from autonomous agencies and institutions which have cut across state boundaries as they attempt to solve problems or meet goals.

12. **CRITERION-REFERENCED MEASURES.** An evaluative procedure used to determine if a student has mastered a performance objective.

13. **CROSS-REFERENCE TABLE.** A table that identifies the relationship among duties and tasks found in the occupational inventory and the performance objectives in the final catalog. Also noted are percentages of incumbents performing the tasks by D.O.T. number.

14. **DICTIONARY OF OCCUPATIONAL TITLES (D.O.T.).** A document published by the U.S. Department of Labor, Employment, and Training Administration. This publication groups occupations into systematic occupational classification structures based on interrelationships of job tasks and requirements.

15. **DISINFECT.** Killing microorganisms which are inside of a living host organism.

16. **DISINFEST.** Killing microorganisms on the surface of an innate object or on the surface of a living organism.

17. **DOMAIN (Occupational Domain).** A group of job titles that are related on the basis of required skills and knowledge. D.O.T. CODE. A nine-digit number used to identify a specific job within a given cluster.

18. **D.O.T. CODE.** A nine-digit number identifying a specific occupation, taken from the Dictionary of Occupational Titles developed by the U.S. Department of Labor.

19. **DUTY.** One of the distinct, major work activities in an occupational area. A duty is made of numerous tasks. A duty lends itself to the design of units of instruction.

20. **ENABLING OBJECTIVES.** Objectives identifying support knowledge, and subskills, that are prerequisites to the mastery of a task.

21. **IN-VITRO.** A Latin term referring to that which is outside of the body.

22. **IN-VIVO.** A Latin term referring to that which is within the body.

23. **OCCUPATIONAL ANALYSIS (Task Analysis).** The process of reviewing elements of a job for the purpose of improving training program content across program levels of vocational-technical education.

24. **OCCUPATIONAL INVENTORY.** An instrument used to obtain responses from workers on what duties and tasks are actually performed in an occupational area.

25. **OCCUPATIONAL INVENTORY (Task Inventory Booklet).** A survey instrument listing tasks performed and tools and equipment used by job incumbents in an occupational domain.

26. **OCCUPATIONAL SURVEY.** The procedures for collecting data to identify the duties and tasks that comprise one or more jobs, job types, or career field ladders for the collection and analysis of information concerning such duties.

27. **PERFORMANCE-BASED INSTRUCTION.** Instruction which requires the learner's demonstration of specific competencies. The desired abilities are selected before the instruction is described and are clearly defined as observable performance objectives.

28. **PERFORMANCE CHECKLIST.** A list of performance steps derived from the performance guide to record acceptable or unacceptable performance of each step of a task.

29. **PERFORMANCE GUIDE (PG).** A series of steps required for performance of a task arranged in the sequence ordinarily followed.

30. **PERFORMANCE OBJECTIVE (PO).** A statement, in precise measurable terms, of a particular behavior to be exhibited by a learner under specified conditions, including a standard of performance.

    a. **Conditions: "Given what?"** Describes the situation, including tools and equipment to be used, and limits under which the tasks will be performed.

    b. **Task: "Does what?"** States the observable activity the learner will perform.

   c. **Standard: "How well?"** Indicates performance required of a successful incumbent worker in an actual job environment.

31. **PSYCHOMOTOR.** Skills which emphasize manipulation of materials or tools.

32. **QUALITY REVIEW.** A review of content by V-TECS director or designated representative to examine quality of content format, and style of curriculum guide.

33. **RESOURCES.** Materials which are used to develop instruction and/or learn specific objectives.

34. **STATE-OF-THE-ART REFERENCE.** Current materials from which information or resources can be found to facilitate instruction.

35. **STATE-OF-THE-ART (SOA) STUDY.** Research conducted to determine the current status of performance-based instructional materials and practices in the domain area under study and to obtain other information that might be useful in catalog development.

36. **TASK.** A unit of work activity which constitutes logical and necessary steps in the performance of a duty. A task has a definite beginning and ending point in its accomplishments and generally consists of two or more definite steps.

37. **TASK ANALYSIS.** The process of reviewing elements of a job for the purpose of improving training program content across program levels of vocational technical education.

38. **TASK CRITICALITY.** That aspect of a task statement which makes its accomplishment crucial to the acceptable performance of a worker or student.

39. **TASK LIST.** A list of individual tasks which correspond to a specific job title(s) derived from V-TECS catalogs.

40. **TEACHING ACTIVITIES.** Methods and/or procedure delivering instructional contents to students.

APPENDIX C

TOOLS AND EQUIPMENT LIST

Tool/Equipment

Pruner, hand
Pliers
Sprayers, hand
Hammer claw
Wheelbarrow
Shovel, round point
Pots, plastic
Hand tool kit
Nozzle, sprayer
Hammer sledge
Hoe, garden
Spade, balling and root
Hose, plastic/rubber
Nozzle, watering
Pump, sprayer
Hand carts
Shovel, scoop
Saw, chain
Rake, leaf
Goggles
Post hole digger
Shears, hedge
Hose couplers
Shovel, square point
Gloves, neoprene
Sharpening stones
Saw, tree
Rotary tillers
Shears, lopping
Stapler gun
Seeder, broadcast
Watering can
Spade, garden
Knife, horticultural
Pruner, pole
Rain gauge
Rake bow
Rotating sprinklers
Flats, various
Dust mask
Sprayers, portable
Boots, neoprene
Fork, pitch

Tool/Equipment (cont.)

Cultivator, garden
Sprayers, high pressure
Shade cloth
Weed whip, gas
Scoop, hand
Hoe, nurserymans
Pipe, plastic
Pots, clay
Caulking gun
Heaters
Fork, spading
Pruner, anvil
Bench, greenhouse
Fan, exhaust
Galvanized wire
Pump, high pressure
Respirators, dust
Thermometer, all weather
Greenhouse, plastic
Valve, shut-off
Aprons, pesticide protective
Greenhouse bench
Fork, mulch
Thermostats
Brushes
Greenhouse water faucets
Controller, watering
Plant ties
Hose, drip irrigation
Shears, cut and hold
Trowel, utility
Pump, irrigation Lawn roller
Water breaker
Plant dolly
Hose reel
Peg boards
Seeder, mechanical
Misting equipment
Soil testing kit
Sprayers, field
Soil thermometer
Weed whip, hand
Thermometer, soil
Fertilizer injector
Shears, grass
Dibble
Duster
Hose, low temperature all-weather
Face shield
Shredder

Tool/Equipment (cont.)

Controller, irrigation
Meter, pH
Nursery bins
Wire mesh
Wick applicator
Magnifiers
Platform trucks
Trowel, cultivating
Heating cables
Knife, budding/grafting
Woven shade lath
Soil mixer
Heat tapes
Planter, bulb
Bed divider
Pressure regulator
Shading, plastic
Plant poles
Leather scabbard
Wire stem cutters
Compost grinder
Shears, ratchet-cut pruning
Tape writer label gun
Plug extractor
Shears, florist
Respirators, full face
Sprayers, air blast
Soil sampler
Plant stand
Meter, moisture
Shading, liquid
Mechanical transplanter
Line strainer
Propagation light
Vase, florist
Fogger
Mist blowers
Evaporative cooling systems
Chipper
Monitor, fertilizer
Testing paper, pH
Meter, light
Thermal alarm
Oil heater
Meter, humidity
Fertility analyzer
Shears, thinning
Grafting tool
Greenhouse washer
Soil sterlizers

Tool/Equipment (cont.)

Mat, capillary
Pipe saddles
Bulb pans
Hoe, warren
Mat, propagating
Eye wash station
Sod plugger
Plant setter
Potting machine
Hot caps
Grafting strips
Sprayers, stationary
Shears, ribbon
Monitor, flow
Mulch laying machines
Hygrometer, wet/dry bulb
Thermometer, recording
Treating carts
Flower stem stripper
Row covers
Steam generators
Thermometer, electronic
Steam aerators
Aerator
Air compressor
Backhoe
Box scraper
Broom
Brush cutter
Bulldozer
Burlap
Circular saw
Clipboard
Compaction vibrator
Container, paper mache
Cultivator
Digger bar
Disc
Drafting table
Drafting tool
Drills
Dumptruck
Flail mower
Front endloader
Golf cart
Graders, for tractors
Grading rake
Landscape blade
Lawn mower
Lister

Tool/Equipment (cont.)

- Loader bucket
- Masonary saw
- Mattock
- Metal stakes
- Nails
- Narrow tractor
- Overseeder
- Plastic tagging ribbon
- Plow
- Plows
- Power saw
- Rabbit guards
- Radical arm saw
- Roller
- Rope
- Skid loader with care tree spade
- Sod cutter
- Sod edger
- Sprayer
- Table saw
- Tape gun
- Tape measure
- Tiller
- Track crawler/blade
- Tractors
- Trailer tandem axil
- Trailer tie-up
- Trailers
- Trailers tandem axil
- Trailers, (transporting containers)
- Trailers, (transporting container)
- Trailer, tie-up
- Tree grader
- Tree spade, mechanical
- Truck (s)
- Trucks
- Trucks, pickup
- Truck, pick-up
- Vans

APPENDIX D

BIBLIOGRAPHY

1. American Nurseryman Publishing Co. Direct mail advertising summary [pamphlet]. Chicago, IL: Author.

2. American Nurseryman Publishing Co. Equal employment opportunity [pamphlet]. Chicago, IL: Author.

3. American Nurseryman Publishing Co. Guide to effective advertising [pamphlet]. Chicago, IL: Author.

4. American Nurseryman Publishing Co. Manual for plant appraisers [pamphlet]. Chicago, IL: Author.

5. American Nurseryman Publishing Co. New employee orientation manual [pamphlet]. Chicago, IL: Author.

6. American Nurseryman Publishing Co. Newspaper advertising summary [pamphlet]. Chicago, IL: Author.

7. American Nurseryman Publishing Co. Operating an effective advertising program [pamphlet]. Chicago, IL: Author.

8. American Nurseryman Publishing Co. Operating cost study [pamphlet]. Chicago, IL: Author.

9. American Nurseryman Publishing Co. Partners for profit advertising manual [pamphlet]. Chicago, IL: Author.

10. American Nurseryman Publishing Co. Preparation guide for a job description manual [pamphlet]. Chicago, IL: Author.

11. American Nurseryman Publishing Co. Radio advertising summary [pamphlet]. Chicago, IL: Author.

12. American Nurseryman Publishing Co. Special labor summary [pamphlet]. Chicago, IL: Author.

13. American Nurseryman Publishing Co. Talking over foremanship [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.

14. American Association of Nurserymen. (1980). American standard of nursery stock. Washington, D.C.: Author.

15. Ashton, F., & Crafts, A. (1981). Modes of action of herbicides (2nd ed.). Somerset, NJ: John Wiley & Sons, Inc.

16. Bailey, L. (1976). Hortus third. Fort Worth, TX: Branch-Smith Publishing.

17. Bailey, L. (1949). Manual of cultivated plants. Fort Worth, TX: Branch-Smith Publishing.

18. Ball, V. (1985). Ball redbook greenhouse growing (14th ed.). Reston, VA: Reston.

19. Ballard, E. (1971). The technical glossary of horticultural and landscape terminology. Chicago, IL: American Nurseryman Publishing Co.

20. Barber, S. (1984). Soil nutrient bioavailability: A mechanist approach. Somerset, NJ: John Wiley & Sons, Inc.

21. Barden, J., Halfacre, G., & Parrish, D. (1987). Plant science. Manchester, MO: McGraw-Hill Book Co.

22. Bartholomew, M. (1981). Square foot gardening. Emmaus, PA: Rodale Press.

23. Beard, J. (1972). Turfgrass: Science and culture. Fort Worth, TX: Branch-Smith Publishing.

24. Beck, R., Banwart, W., & Hassett, J. (1984). Introductory soil science a laboratory. Champaign, IL: Stipes Publishing Co.

25. Bennett, C. (1983). Conservation and management of natural resources in the United States. Somerset, NJ: John Wiley & Sons, Inc.

26. Berninger, L. (1981). Profitable garden center management. Chicago, IL: American Nurseryman Publishing Co.

27. Boodley, J. (1981). The commercial greenhouse. Albany, NY: Delmar Publishers Inc.

28. Bosworth, D., & Foster, A. (1982). Approved practices in soil conservation. Danville, IL: The Interstate Printers & Publishers, Inc.

29. Bowers, W., Jones, B., & Olver, E. (1986). Engineering applications in agriculture. Champaign, IL: Stipes Publishing Co.

30. Boyd, J. (1979). Practical farm buildings. Danville, IL: The Interstate Printers & Publishers, Inc.

31. Brady, N. (1974). The nature and properties of soils (8th ed.). New York, NY: Macmillan.

32. Briggs, G., & Calvin, C. (1986). Indoor plants. Chicago, IL: American Nurseryman Publishing Co.

33. Brown, A., & Strickland, R. (1973). Tractor and small engine maintenance. Danville, IL: The Interstate Printers & Publishers, Inc.

34. Bubel, N. (1978). Seed-starter's handbook. Emmaus, PA: Rodale Press.

35. Buchel, K. (1983). Chemistry of pesticides. Somerset, NJ: John Wiley & Sons, Inc.

36. Buchholz, D. (1985). How to get a good soil sample: An agricultural guide. Columbia, MO: Cooperative Extension Service, University of Missouri-Columbia.

37. Bush-Brown, J., & Bush-Brown, L. (1967). America's garden book. New York, NY: Charles Scribner's Sons.

38. Carpenter, Walker, & Lanphear. (1975). Plants in the landscape. Fort Worth, TX: Branch-Smith Publishing.

39. Carr, A. (1983). Rodale's color handbook of garden insects. Emmaus, PA: Rodale Press.

40. Chase, A. (1987). Compendium of ornamental foliage plant diseases. Chicago, IL: American Nurseryman Publishing Co.

41. Coggin, Armstrong, & Giles. (1987). A manual on sharpening hand woodworking tools. Danville, IL: The Interstate Printers & Publishers, Inc.

42. Conover, H. (1958). Grounds maintenance handbook (3rd ed.). Fort Worth, TX: Branch-Smith Publishing.

43. Conway, G. (1984). Pest and pathogen control: Strategy, tactics, and policy models. Somerset, NJ: John Wiley & Sons, Inc.

44. Cooper, E. (1987). Agricultural mechanics: Fundamentals and applications. Albany, NY: Delmar Publishers Inc.

45. Cooperative Extension Service, Cornell University. (1981). Cornell recommendations for commercial floriculture crops part 1: Cultural practices and production programs. Ithaca, NY: Author.

46. Council of Tree and Landscape Appraisers. Guide for establishing values of trees and other plants. Chicago, IL: American Nurseryman Publishing Co.

47. Courtright, G. (1979). Trees and shrubs for temperate climates. Fort Worth, TX: Branch-Smith Publishing.

48. Cox, J., & Cox, M. (1985). The perennial garden color harmonies through the seasons. Emmaus, PA: Rodale.

49. Cullman, Goetz, & Groner. (1987). Encyclopedia of cacti. Portland, OR: Timber Press.

50. Curtis, P., & Courson, R. (1981). Outline of soil fertility and fertilizers. Champaign, IL: Stipes Publishing Co.

51. Dadant, C. (1982). First lesson in beekeeping. Danville, IL: The Interstate Printers & Publishers, Inc.

52. Daniel, W., & Freeborg, R. (1980). Turf managers' handbook. Cleveland, OH: Harvest.

53. Danks, S., Evans, E., & Whittaker, P. (1983). Photosynthetic systems: Structure, function and assembly. Somerset, NJ: John Wiley & Sons, Inc.

54. Daute, H. (1986). Macmillan book of bonsai. New York, NY: Collier Books.

55. Davidson, H., & Mecklenburg, R. (1981). Nursery management administration and culture. Englewood Cliffs, NJ: Prentice Hall.

56. Davies, D., Eagle, D., & Finney J. (1982) Soil management. Fort Atkinson, WI: Nasco.

57. DeHertogh, A. (1985). Holland bulb forcer's guide (3rd ed.). Hillegom, Netherlands: International Flower-Bulb Centre.

58. Denisen. (1979). Principles of horticulture. New York, NY: Macmillan.

59. Dictionary of Gardening. (1956). A practical and scientific encyclopedia of horticulture (2nd ed.). New York, NY: Oxford University Press.

60. Dirr, M. (1978). Photographic manual of woody landscape plants. Champaign, IL: Stipes Publishing Co.

61. Dirr, M. (1983). Manual of woody landscape plants: their identification, ornamental characteristics, culture, propagation and uses (3rd ed.). Champaign, IL: Stipes Publishing Co.

62. Donahue, R., Follett, R., & Tulloch, R. (1983). Our soils and their management. Danville, IL: The Interstate Printers & Publishers, Inc.

63. Douglas, J. (1975). Hydroponics: The bengal system, with notes on other methods of soilless cultivation (5th ed.). New York, NY: Oxford University Press.

64. Downey, D., & Erickson, S. (1987). Agribusiness management (2nd ed.). Manchester, MO: McGraw-Hill Book Co.

65. Edmond, J., & Senn, T. (1975). Fundamentals of horticulture (4th ed.). Manchester, MO: McGraw-Hill Book Co.

66. Emmons, R. (1984). Turfgrass science and management. Albany, NY: Delmar.

67. Engelstad, O. (1985). Fertilizer technology and use. Madison, WI: Soil Science Society of America, Inc.

68. Evans, D., Sharp, W., Ammirats, P., & Yamada, Y. (Eds.). (1983). Handbook of plant cell culture (Vols. 1-3). New York, NY: Macmillan.

69. Fell, D. (1983). Annuals: How to select, grow and enjoy. Tucson, AZ: HP Books.

70. Flint, H. (1983). Landscape plants for eastern North America. Somerset, NJ: John Wiley & Sons, Inc.

71. Foth, H. (1984). Fundamentals of soil science (7th ed.). Somerset, NJ: John Wiley & Sons, Inc.

72. Furuta, T. (1983). Interior landscaping. Fort Worth, TX: Branch-Smith Publishing.

73. Garden Center of America. (1986). Garden center business forms. Chicago, IL: American Nurseryman Publishing Co.

74. Garden Centers of America. (1986). Garden center policy manual [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.

75. Garden Centers of America. (1986). Interviewing and hiring employees [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.

76. Garden Club of America. (1984). Plants that merit attention. Fort Worth, TX: Branch-Smith Publishing.

77. Garner, R. (1979). The grafter's handbook. (4th ed.). Boston, MA: Faber and Faber.

78. Giles, F. (1986). Landscape construction procedures, techniques, and design. Champaign, IL: Stipes Publishing Co.

79. Graf, A. (1975). Exotic plant manual. Fort Worth, TX: Branch-Smith Publishing.

80. Graf, A. (1976). Exotic house plants. Fort Worth, TX: Branch-Smith Publishing.

81. Graf, A. (1985). Exotic 4 (Vols. 1 & 2). Fort Worth, TX: Branch-Smith Publishing.

82. Graham. (1987). Growing succulent plants. Portland, OR: Timber Press.

83. Hahn, O. (1986). Macmillan book of ornamental gardening. New York, NY: Collier Books.

84. Halfacre, G., & Barden, J. (1979). Horticulture. Manchester, MO: McGraw-Hill Book Co.

85. Hanan, J., Holley, W., & Goldsberry, K. (1978). Greenhouse management. New York, NY: Springer-Berlag.

86. Hannebaum, L. (1981). Landscape design. Fort Worth, TX: Branch-Smith Publishing.

87. Hannebaum, L. (1980). Landscape operations. Reston, VA: Reston.

88. Harness & D'Angelo. (1987). The Bernard E. Harness seedlist handbook. Portland, OR: Timber Press.

89. Harper, P., & McGourty, F. (1985). Perennials. Tucson, AZ: HP Books.

90. Hartman, H., & Kester, D. (1983). Plant propagation principles and practices (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.

91. Haskell, P. (1985). Pesticide application: Principles and practices. New York, NY: Oxford University Press.

92. Herwig, R., & Shubert, M. (1984). Treasury of houseplants. New York, NY: Collier Books.

93. Hessayon, D. (1981). House plant expert. New York, NY: Charles Scribner's Sons.

94. Hirsch, D. (1977). Indoor plants comprehensive care and culture. Radnor, PA: Chilton.

95. Holtz, H. (1982). How to succeed as an independent consultant. Somerset, NJ: John Wiley & Sons, Inc.

96. Hoover, N. (1979). Approved practices in beautifying the home grounds. Fort Atkinson, WI: Nasco.

97. Horticultural Research Institute. Uniform chart of accounts. Chicago, IL: American Nurseryman Publishing Co.

98. Hudak, J. (1980). Trees for every purpose. Fort Worth, TX: Branch-Smith Publishing.

99. Huxley, A. (1984). World guide to house plants: Origins, care and cultivation. New York, NY: Charles Scribner's Sons.

100. Ingels, J. (1985). Ornamental horticulture: Principles and practices. Albany, NY: Delmar Publishers Inc.

101. Ingels, J. (1987). Landscaping: Principles and practices (3rd ed.). Albany, NY: Delmar Publishers Inc.

102. Irragation Technical Services. (1982). The abc's of lawn sprinkler systems. LaFayette, CA: Author.

103. Israelsen, O., & Hansen, V. (1980). Irrigation principles and practices. Fort Atkinson, WI: Nasco.

104. Janick, J. (1983). Horticultural science (2nd ed.). San Francisco, CA: W.H. Freeman.

105. John Deere Service Publications. (1973). Fundamentals of machine operation: Preventive maintenance. Moline, IL: Author.

106. John Deere Service Publications. (1979). Fundamentals of service: Power trains (4th ed.). Moline, IL: Author.

107. John Deere Service Publications. (1980). Fundamentals of service: Belts and chains (3rd ed.). Moline, IL: Author.

108. John Deere Service Publications. (1980). Fundamentals of service: Engines (5th ed.). Moline, IL: Author.

109. John Deere Service Publications. (1980). Fundamentals of service: Mowing and spraying equipment (5th ed.). Moline, IL: Author.

110. Johnson. (1979). Introduction to soil science study guide. New York, NY: Macmillan.

111. Kay, R. (1986). Farm management: Planning, control, and implementation (2nd ed.). Manchester, MO: McGraw-Hill Book Co.

112. Klingman, G, Ashton, F., & Noordhoff, L. (1982). Weed science: Principles and practices (2nd ed.). Somerset, NJ: John Wiley & Sons, Inc.

113. Kohnke, H. (1980). Soil science simplified. Fort Atkinson, WI: Nasco.

114. Kooi, C. (1985). Estimating and management principles for landscape contractors. Chicago, IL: American Nurseryman Publishing Co.

115. Kreuter, M. (1985). Macmillan book of organic gardening. New York, NY: Collier Books.

116. Krussman, G. (1985). Manual of cultivated broad leaved trees and shrubs (Vol. 3). Fort Worth, TX: Branch-Smith Publishing.

117. Kyte, L. (1983). Plants from test tubes: An introduction to micropropagation. Portland, OR: Timber Press.

118. Langhans, R. (1983). Greenhouse management. Fort Worth, TX: Branch-Smith Publishing.

119. Laurie, A., Kiplinger, D. & Nelson. (1979). Commercial flower forcing (8th ed.). Manchester, MO: McGraw-Hill Book Co.

120. MacCaskey, M. (1982). Lawns and Ground Covers: How to select, grow, and enjoy. Tucson, AZ: HP Books.

121. MacDonald, B. (1986). Practical woody plant propagation for nursery growers (Vol. 1). Fort Worth, TX: Branch-Smith Publishing.

122. Manaker, G. (1987). Interior plantscapes. Fort Worth, TX: Branch-Smith Publishing.

123. McKenzie, B., & Zachariah, G. (1982). Understanding and using electricity. Danville, IL: The Interstate Printers & Publishers, Inc.

124. McVickar, M., & Walker, W. (1978). Using commercial fertilizers. Danville, IL: The Interstate Printers & Publishers, Inc.

125. Metcalf, C., Flint, W., & Metcalf, R. (1962). Destructive and useful insects (4th ed.). Manchester, MO: McGraw-Hill Book Co.

126. Metcalf, R., & Luckmann, W. (1982). Introduction to insect pest management. Somerset, NJ: John Wiley & Sons, Inc.

127. Minnich, J., Hunt, M. (1979). Rodale guide to composting. Emmaus, PA: Rodale Press.

128. Mortenson, W. (1977). Modern marketing of farm products. Danville, IL: The Interstate Printers & Publishers, Inc.

129. Nelson, K. (1978). Flower and plant production in the greenhouse. Danville, IL: The Interstate Printers & Publishers, Inc.

130. Nelson, K. (1980). Greenhouse management for flower and plant production. Danville, IL: The Interstate Printers & Publishers, Inc.

131. Nelson, P. (1978). Greenhouse operations and management. Reston, VA: Reston.

132. Nelson, W. (1985). Planting design: A manual of theory and practice. Champaign, IL: Stipes Publishing Co.

133. Ortho Books. (1977). The world of cactus & succulents. San Francisco, CA: Author.

134. Ortho Books. (1978). All about pruning. San Francisco, CA: Author.

135. Ortho Books. (1978). The world of herbs & spices. San Francisco, CA: Author.

136. Ortho Books. (1980). All about landscaping. San Francisco, CA: Author.

137. Ortho Books. (1980). How to select and care for shrub and hedges. San Francisco, CA: Author.

138. Ortho Books. (1981). All about perennials. San Francisco, CA: Author.

139. Ortho Books. (1981). How to select, use and maintain garden equipment. San Francisco, CA: Author.

140. Ortho Books. (1982). All about ground covers. San Francisco, CA: Author.

141. Ortho Books. (1982). All about houseplants. San Francisco, CA: Author.

142. Ortho Books. (1982). All about trees. San Francisco, CA: Author.

143. Ortho Books. (1982). Easy maintenance gardening. San Francisco, CA: Author.

144. Ortho Books. (1982). Shade gardening. San Francisco, CA: Author.

145. Ortho Books. (1983). All about roses. San Francisco, CA: Author.

146. Ortho Books. (1983). Gardening in containers. San Francisco, CA: Author.

147. Ortho Books. (1984). All about evergreens. San Francisco, CA: Author.

148. Ortho Books. (1984). Gardening techniques. San Francisco, CA: Author.

149. Ortho Books. (1984). Landscaping with wildflowers and native plants. San Francisco, CA: Author.

150. Ortho Books. (1985). *African violets & flowering houseplants*. San Francisco, CA: Author.

151. Ortho Books. (1985). *All about azaleas, camellias and rhododendrons*. San Francisco, CA: Author.

152. Ortho Books. (1985). *All about lawns*. San Francisco, CA: Author.

153. Ortho Books. (1986). *All about bulbs*. San Francisco, CA: Author.

154. Ortho Books. (1987). *Controlling lawn & garden insects*. San Francisco, CA: Author.

155. Oster, M., Carlson, J., & Curry E. (1984). *Farmland buying strategies*. Somerset, NJ: John Wiley & Sons, Inc.

156. Page, B., & Thomson, W. (1987). *Insecticide, herbicide, fungicide quick guide*. Fort Atkinson, WI: Nasco.

157. Pfadt. (1985). *Fundamentals for applied entomology*. New York, NY: Macmillan.

158. Pfahl, P. (1983). *The retail florist business*. Fort Worth, TX: Branch-Smith Publishing.

159. Pfahl, P., & Kalin, E. (1982). *American style flower arranging*. Englewood Cliffs, NJ: Prentice-Hall.

160. Pinney, J., & Pinney, R. *Beginning in the nursery business* [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.

161. Pirone, P. (1972). *Tree maintenance* (5th ed.). New York, NY: Oxford University Press.

162. Pirone, P. (1978). *Disease and pests of ornamental plants* (5th ed.). New York, NY: Wiley.

163. Plaster, E. (1985). *Soil science and management*. Albany, NY: Delmar Publishers Inc.

164. Poincelot, R. (1986). *No-dig, no-weed gardening*. Emmaus, PA: Rodale Press.

165. Price, P. (1984). *Insect ecology* (2nd ed.). Somerset, NJ: John Wiley & Sons, Inc.

166. Radosevich, S., & Holt, J. (1984). Weed ecology: Implications for vegetation management. Somerset, NJ: John Wiley & Sons, Inc.

167. Rehder, A. (1986). Manual of cultivated trees and shrubs hardy in North America. Chicago, IL: American Nurseryman Publishing Co.

168. Rice. (1986). A handbook of annuals and bedding plants. Portland, OR: Timber Press.

169. Richardson, D., & Meheriuk, M. (1982). Controlled atmospheres for storage and transport of perishable agricultural commodities. Portland, OR: Timber Press.

170. Richter, H., & Schwan, W. (1986). Wiring simplified. Danville, IL: The Interstate Printers & Publishers, Inc.

171. Rix. (1984). Growing begonias. Portland, OR: Timber Press.

172. Root, E., & Root, H. (1983). ABC & xyz of bee culture. Fort Atkinson, WI: Nasco.

173. Roth, A., & Baird, R. (1985). Small gas engines. Fort Atkinson, WI: Nasco.

174. Sabey, B. (1969). Introductory experimental soil science. Champaign, IL: Stipes Publishing Co.

175. Sarna, R. (1980). Chain saw manual. Danville, IL: The Interstate Printers & Publishers, Inc.

176. Schmidt, J., Lewis, W., & Olin, H. (1983). Construction: Principles, materials & methods. Danville, IL: The Interstate Printers & Publishers, Inc.

177. Schneeberger, K., & Osburn, D. (1977). Financial planning in agriculture. Danville, IL: The Interstate Printers & Publishers, Inc.

178. Schwab, G., Frevert, R., Edminister, T., & Barnes, K. (1981). Soil and water conservation engineering (3rd ed.). Somerset, NJ: John Wiley & Sons, Inc.

179. Scott, G. (1982). Bulbs: How to select, grow and enjoy. Tucson, AZ: HP Books.

180. Shewell, & Cooper. (1975). Compost gardening. New York, NY: Macmillan.

181. Shumack, R., & Williams, G. (1983). Greenhouse flowers and bedding plants. Danville, IL: The Interstate Printers & Publishers, Inc.

182. Singer. (1986). Soils; An introduction. New York, NY: Macmillan.

183. Smith, M. (1985). Greenhouse gardening. Emmaus, PA: Rodale Press.

184. Soil Improvement Committee and California Fertilizer Association. (1986). Western fertilizer handbook. Danville, IL: The Interstate Printers & Publishers, Inc.

185. Sopher, & Baird. (1981). Soils and soil management. Fort Worth, TX: Branch-Smith Publishing.

186. Sperka, M. (1984). Growing wildflowers. New York, NY: Charles Scribner's Sons.

187. Sprague, H. (1982). Turf management handbook. Fort Worth, TX: Branch-Smith Publishing.

188. Staples, R., & Toenniessen, G. (1984). Salinity tolerance in plants: Strategies for crop improvement. Somerset, NJ: John Wiley & Sons, Inc.

189. Stebbins, R., & MacCaskey, M. (1983). How to guide for gardeners. Tucson, AZ: HP Books.

190. Still, S. (1982). Herbaceous ornamental plants. Champaign, IL: Stipes Publishing Co.

191. Stout, R., & Clemence, R. (1971). Ruth Stout no-work garden book. Emmaus, PA: Rodale Press.

192. Strohm, G. Closing more sales [pamphlet]. Chicago, IL: American Nurseryman Publishing Co.

193. Sullivan, Robertson, & Staby. (1980). Management for retail florists with applications. Fort Worth, TX: Branch-Smith Publishing

194. Sunset Books. (1972). Herbs. Menlo Park, CA: Lane Publishing Co.

195. Sunset Books. (1974). Garden pools, fountains & waterfalls. Menlo Park, CA: Lane Publishing Co.

196. Sunset Books. (1976). *Bonsai*. Menlo Park, CA: Lane Publishing Co.

197. Sunset Books. (1976). *Greenhouse gardening*. Menlo Park, CA: Lane Publishing Co.

198. Sunset Books. (1977). *African violets: How to grow*. Menlo Park, CA: Lane Publishing Co.

199. Sunset Books. (1977). *Orchids*. Menlo Park, CA: Lane Publishing Co.

200. Sunset Books. (1978). *Cactus and succulents*. Menlo Park, CA: Lane Publishing Co.

201. Sunset Books. (1978). *Landscaping & gardening remodeling*. Menlo Park, CA: Lane Publishing Co.

202. Sunset Books. (1979). *Lawns & ground covers*. Menlo Park, CA: Lane Publishing Co.

203. Sunset Books. (1980). *Decorating with plants*. Menlo Park, CA: Lane Publishing Co.

204. Sunset Books. (1980). *Roses*. Menlo Park, CA: Lane Publishing Co.

205. Sunset Books. (1981). *Basic gardening illustrated*. Menlo Park, CA: Lane Publishing Co.

206. Sunset Books. (1981). *Garden color/annuals & perennials*. Menlo Park, CA: Lane Publishing Co.

207. Sunset Books. (1982). *Azaleas, rhododendrons, camellias*. Menlo Park, CA: Lane Publishing Co.

208. Sunset Books. (1983). *Gardener answer book*. Menlo Park, CA: Lane Publishing Co.

209. Sunset Books. (1983). *House plants*. Menlo Park, CA: Lane Publishing Co.

210. Sunset Books. (1983). *Pruning handbook*. Menlo Park, CA: Lane Publishing Co.

211. Sunset Books. (1984). *Container gardening*. Menlo Park, CA: Lane Publishing Co.

212. Sunset Books. (1984). *Landscaping illustrated*. Menlo Park, CA: Lane Publishing Co.

213. Sunset Books. (1985). Bulbs for all seasons. Menlo Park, CA: Lane Publishing Co.

214. Sunset Books. (1985). Landscaping for privacy. Menlo Park, CA: Lane Publishing Co.

215. Symonds, G. (1963). The shrub identification book. Fort Atkinson, WI: Nasco.

216. Teare, I. & Pet, M. (1982). Crop-water relations. Somerset, NJ: John Wiley & Sons, Inc.

217. The Interstate Printers & Publishers, Inc. (1986). Doane's field and equipment record book. Danville, IL: Author.

218. Tisdale. (1985). Soil fertility & fertilizers (4th ed.). New York, NY: Macmillan.

219. Tompkins, & Griffith. (1977). Practical beekeeping. Fort Atkinson, WI: Nasco.

220. Turgeon, A. (1980). Turf grass management. Reston, VA: Reston.

221. Turgeon, A., Street, J., Giles, F., Schurtleff, M., & Randell, R. (1980). Illinois lawn care and establishment. (Circular 1082). Urbana, IL: Cooperative Extension Service, University of Illinois at Urbana-Champaign.

222. Uchtmann, D., Looney, J., Krausz, & Hannah. (1981). Agricultural law: Principles and cases. Manchester, MO: McGraw-Hill Book Co.

223. U.S. Department of Agriculture, Soil Conservation Service. (1975). Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Somerset, NJ: John Wiley & Sons, Inc.

224. Veen, T. (1986). Rhododendrons in America. Fort Worth, TX: Branch-Smith Publishing.

225. Wakeman, T. (1977). Modern agricultural mechanics. Danville, IL: The Interstate Printers & Publishers, Inc.

226. Ware, G. (1980). Complete guide to pest control. Fresno, CA: Thompson Publications.

227. Wells, J. (1985). Plant propagation (Vols. 1 & 2). Chicago, IL: American Nurseryman Publishing Co.

228. Welsh, J. (1981). Fundamentals of plant genetics and breeding. Somerset, NJ: John Wiley & Sons, Inc.

229. Wetherell, D. (1982). Introduction to in vitro propagation. Wanye, NJ: Avery.

230. Whitcomb, C. (1984). Plant production in containers. Fort Worth, TX: Branch-Smith Publishing.

231. Williams, G., & Shumack, R. (1984). Nursery crops and landscape designs. Danville, IL: The Interstate Printers & Publishers, Inc.

232. Willson, M. (1983). Plant reproductive ecology. Somerset, NJ: John Wiley & Sons, Inc.

233. Yepsen, R., Jr. (1984). The encyclopedia of natural insect and disease control. Emmaus, PA: Rodale Press.

234. Youngs. (1986). Collecting, processing and germinating seeds of wildland plants. Portland, OR: Timber Press.

APPENDIX D (cont.)

BIBLIOGRAPHY: STATE-OF-THE-ART LITERATURE

1. American Society for Horticulture Science, Alexandria, VA 1986.
2. Bureau of Labor Statistics. (1985). Occupational Outlook Handbook. Washington, DC: U.S.Government Printing Office.
3. Career Opportunities. (1970). (Agriculture Technicians). Chicago: J. G. Ferguson.
4. Gale, B. and Gale L. (1979). National Career Directory. New York: Arco Publishing Inc.
5. Hopke, J. (1984). Encyclopedia of Careers and Vocational Guidance. Chicago: J. G. Ferguson.
6. Horticulture Now. September 1985.
7. Illinois Department of Employment Security. (1982). Occupational Projections 1980-1990, State of Illinois. Chicago: Research and Analysis Department.
8. Illinois Department of Employment Security. (1986). 1982-1995 Occupational Projections State of Illinois. Chicago: Economic Information and Analysis Division.
9. Illinois Services Directory. (1984). Chicago: Manufacturer's News Inc.
10. Standard Periodical Directory. (1984). New York: Oxbridge Communications Inc.
11. United States Department of Labor. (1985). Careers Guidebook. Washington, DC: U.S.Government Printing Office.
12. United States Department of Labor. Dictionary of Occupational Titles. (1977). Washington, DC: Employment and Training Administration.
13. United States Department of Labor. (1985, Spring). Occupational Outlook Quarterly. Washington, DC: U.S. Government Printing Office.

PERSONAL INTERVIEWS:

1. Dickerson, Debbie; Illinois Department of Agriculture, Springfield, IL 1986.
2. Frank, Robert; Jackson County Extension Agent, Murphysboro, IL 1986.
3. Hanley, Tammy; Illinois Department of Agriculture, Springfield, IL 1986.
4. Hilen, Andrew G.; Professor of Plant and Soil Science, Southern Illinois University, Carbondale, IL 1986.
5. Illinois Department of Agriculture, Springfield, IL 1986.
6. Illinois Department of Commerce and Community Affairs, Occupational Training Department, Springfield, IL 1986.
7. Illinois Department of Commerce and Community Affairs, Research Department, Springfield, IL 1986.
8. Illinois Department of Labor, Job Service, State of Illinois, Chicago, IL 1986.
9. Illinois Department of Labor Statistics, Springfield, IL 1986.
10. Preece, John E.; Professor of Plant and Soil Science, Southern Illinois University, Carbondale, IL 1986.
11. United States Department of Agriculture, Washington, DC. 1986.
12. United States Department of Labor, Bureau of Employment Security, Chicago, IL 1986.
13. Vogel, Randy; Illinois Nurserymen's Association, Springfield, IL 1986.
14. Walker, Tom; Illinois Department of Agriculture, Springfield, IL 1986.

Professional Organizations:

U.S. Dept. of Agriculture
Washington, DC 20250

American Institute of Biological Sciences
1401 Wilson Blvd.
Arlington, VA 22209

American Horticultural Society
National Center for American Horticulture
Mount Vernon, VA 22121

American Association of Nurserymen
230 Southern Bldg.
Washington DC 20005

American Society for Horticultural Science
701 N. Saint Asaph
Alexandria, VA 22314

Foliage Education and Research Foundation
P.O. Box 4
Apopka, FL 32703

International Plant Propagators' Society
Dept. of Horticulture
Purdue University
W. Layfayette, IN 47907

The American Plant Life Society
2678 Preswik Court
LaJolla, CA 92037

Trade Publications:

ALI. Affiliated with the American Association of Nurserymen. Washington DC.

Alberta Horticulturist. Ed. Chris Campbell. Affiliated with the Alberta Horticultural Association. Alta, Canada.

American Association of Nurserymen-Member Directory. Affiliated with the American Association of Nurserymen. Washington DC.

American Horticulturist. Ed. Jody Powell. Affiliated with the American Horticultural Society. Mt. Vernon, VA.

American Society for Horticultural Science Journal. Alexandria, VA.

Arnoldia. Ed. Barbara O. Epstein. Affiliated with Harvard University. Jamaica Plain, MA.

Bio-Dynamics. Ed. Heinz Grotzke. Affiliated with Dio-Dynamic Association. Wyoming, RI.

The Digger. Ed. Dan Barnhart. Affiliated with the Oregon Association of Nurserymen. Portland, OR.

Flowers and Foliage Plants. U.S. Dept. of Agriculture Washington DC.

Foliage Digest. Ed. Jean Pate. Affiliated with Foliage Education and Research Foundation. Apopka, FL.

Greenhouse Canada. Ed. Jim Brown. Growth Publications Ltd., Milliken, Ortario, Canada.

Greenhouse Industry. Statistics Canada Publications. Ottawa, Ontario, Canada.

Horticulture News. Ed. Eric Young. Affiliated with the New Jersey State Horticultural Society. New Brunswick, NJ.

Horticulture. Ed. Thomas Cooper. Published by the Horticulture Associates. Boston, MA.

Horticulture Digest. Ed. Fred Rauch. Affiliated with the University of Hawaii. Honolulu, HI.

Hortus. Ed. Cliff Martin. Published by ISBS, Inc. Forest Grove, OR.

International Plant Propagators' Society Proceedings. Ed. Dr. Hudson Hartmann. Affiliated with the International Plant Propagators' Society. W. Lafayette, IN.

Journal of Arboriculture. Ed. Dr. Dan Neely. Affiliated with the International Society of Arboriculture. Urbana, IL.

Michigan State Horticultural Society Report. Ed. Jerome Hill. Affiliated with Michigan State University East Lansing, MI.

Minnesota Horticulturist. Ed. JoAnn Ray. Affiliated with the Minnesota State Horticultural Society. St. Paul, MN.

Nurseries. Affiliated with the North Dakota Dept. of Agriculture.

OAN Digger. Ed. Carl Plog. Affiliated with the Oregon Association of Nurserymen. Portland, OR.

Ornamental Horticulture Abstracts. Published by Unipub. NY, NY.

Pacific Horticulture. Ed. W. G. Waters. Affiliated with the Pacific Horticultural Foundation. San Francisco, CA.

Southern Florist and Nurseryman. Ed. Mike Branch. Branch-Smith Publishing. Ft. Worth, TX.

Tennessee Horticulture. Affiliated with the University of Tennessee Agricultural Extension Service. Knoxville, TN.

Update. Affiliated with the American Association of Nurserymen. Washington DC.

APPENDIX D (cont.)

BIBLIOGRAPHY: SOURCES OF STANDARDS

1. American Standard of Nursery Stock. (1980). Washington, D.C.: American Association of Nurserymen.

2. Ball, V. (1985). Ball Redbook Greenhouse Growing (14th edition). Reston, VA: Reston.

3. Buchholz, D. (1985). How to get a good soil sample. In Agricultural Guide. Columbia: Cooperative Extension Service, University of Missouri-Columbia.

4. Bush-Brown, J. and Bush-Brown, L. (1980). America's Garden Book. New York: Charles Scribner's Sons.

5. Cornell Recommendations for Commercial Floriculture Crops Part 1: Cultural Practices and Production Programs. (1981). Ithaca: Cooperative Extension, Cornell University.

6. Cox, J. and Cox, M. (1985). The Perennial Garden Color Harmonies through the Seasons. Emmaus: Rodale.

7. Davidson, H. and Mecklenburg, R. (1981). Nursery Management Administration and Culture. Englewood Cliffs: Prentice Hall.

8. DeHertogh, A. (1985). Holland Bulb Forcer's Guide (3rd edition). Hillegom, Netherlands: International Flower-Bulb Centre.

9. Emmons, R. (1984). Turfgrass Science and Management. Albany: Delmar.

10. Fundamentals of Machine Operation: Preventive Maintenance. (1973). Moline, IL: John Deere Service Publications.

11. Fundamentals of Service: Belts and Chains. (3rd edition). (1980). Moline, IL: John Deere Service Publications.

12. Fundamentals of Service: Engines. (5th edition). (1980). Moline, IL: John Deere Service Publications.

13. Fundamentals of Service: Mowing and Spraying Equipment. (5th edition). (1980). Moline, IL: John Deere Service Publications.

14. Fundamentals of Service: Power Trains. (4th edition). (1979). Moline, IL: John Deere Service Publications.

15. Hartman, H.T., and Kester, D.E. (1983). Plant Propagation Principles and Practices (4th edition). Englewood Cliffs: Prentice-Hall.

16. Janick, J. (1972). Horticultural Science (2nd edition). San Francisco: W.H.Freeman.

17. Kyte, L. (1983). Plants From Test Tubes an Introduction to Micropropagation. Portland: Timber Press.

18. Ornamental Horticulture Production Occupations Writing Team, Illinois.

19. Pirone, P. (1972). Tree Maintenance. (5th edition). New York: Oxford University Press.

20. Staby, G., Robertson, J., Kiplinger, D., and Conover, C. (1978). Chain of Life., (Horticulture Series No 432). Columbus: Ohio Florists Association.

21. Turgeon, A., Street, J., Giles, F., Schurtleff, M., and Randell, R. (1980). Illinois Lawn Care and Establishment. (Circular 1082). Urbana: Cooperative Extension Service, University of Illinois at Urbana-Champaign.

22. Wetherell, D. (1982). Introduction to In Vitro Propagation. Wayne, N.J.: Avery.